AUDELS MASONS AND BUILDERS GUIDE

WHEN we build, let us think that we build forever. Let it not be for present delight nor for present use alone. Let it be such work as our descendants will thank us for; and let us think, as we lay stone on stone, that a time is to come when those stones will be held sacred because our hands have touched them, and that men will say, as they look upon the labor and wrought substance of them, "See! This our father did for us."

—*John Ruskin.*

Throwing Mortar—3rd Position

Completion of stroke, Trowel in vertical plane. In bringing the trowel back and forth to spread the mortar, it is gradually turned upside down.

Brick Laying—1st Position

The brick is held in hand with thumb on one side, forefinger on top and other three fingers on other side of brick, palm of hand on a brick.

"BY HAMMER AND HAND ALL THINGS DO STAND"

AUDELS MASONS AND BUILDERS GUIDE #1

A PRACTICAL ILLUSTRATED TRADE ASSISTANT ON MODERN CONSTRUCTION

FOR BRICKLAYERS - STONE MASONS
CEMENT WORKERS - PLASTERERS
AND TILE SETTERS

EXPLAINING IN PRACTICAL, CONCISE LANGUAGE AND BY WELL DONE ILLUSTRATIONS, DIAGRAMS CHARTS, GRAPHS AND PICTURES, PRINCIPLES ADVANCES, SHORT CUTS - BASED ON MODERN PRACTICE - INCLUDING INSTRUCTIONS ON HOW TO FIGURE AND CALCULATE VARIOUS JOBS

BY

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Foreword

"The Audel's Guides to the Building Trades" are a practical series of educators on the various branches of Modern Building Construction and are dedicated to Master Builders and their Associates.

These Guides are designed to give technical trade information in concise, accurate, plain language.

The Guides illustrate the hows and whys, short cuts, modern ways and methods of the foundation principles of the art.

Each book in the series is fully illustrated and indexed for readiest form of reference and study.

The Guides will speak for themselves—and help to increase the reader's knowledge and skill in the Building Trades.

—*Publishers.*

OUTLINE OF CHAPTERS

How to Use the Guides

When using the Guides as *instruction* books, map out a course of study by consulting the table of contents in each volume: when using them as a reference work, consult the index.

1. Read the index and look up items you do not understand.
2. Review the portions of text you find difficult to understand.
3. Do not be satisfied in memorizing a rule or formula; *understand* the principle upon which it depends.
4. It is better to understand the basic principle of any rule or formula, than to trust to memory.
5. Studying without system is like a ship at sea without a rudder.
6. Do not get into the habit of reading, and thinking about something else at the same time.
7. Read the text and ***concentrate*** upon what you are reading.
8. If you ***will concentrate completely*** on the text matter you may find that ***one reading is all that is needed.***
9. After studying a section of the text, make a list of questions covering the subject treated, and review the text till you can answer all the questions.
10. Study each step thoroughly and review it before going on to the next.
11. Master one subject before you take up another.
12. Study when the mind is clear and you are rested; it is difficult to concentrate when tired.

WHEN TO DO YOUR READING

Read on trains, street cars, lunch hours and use the Guides constantly for reference. You can easily find 30 minutes each day for this important work. It is well to study at stated times and keep up the practice until it becomes a habit.

READY REFERENCE INDEX

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CHAPTER 61

Historical

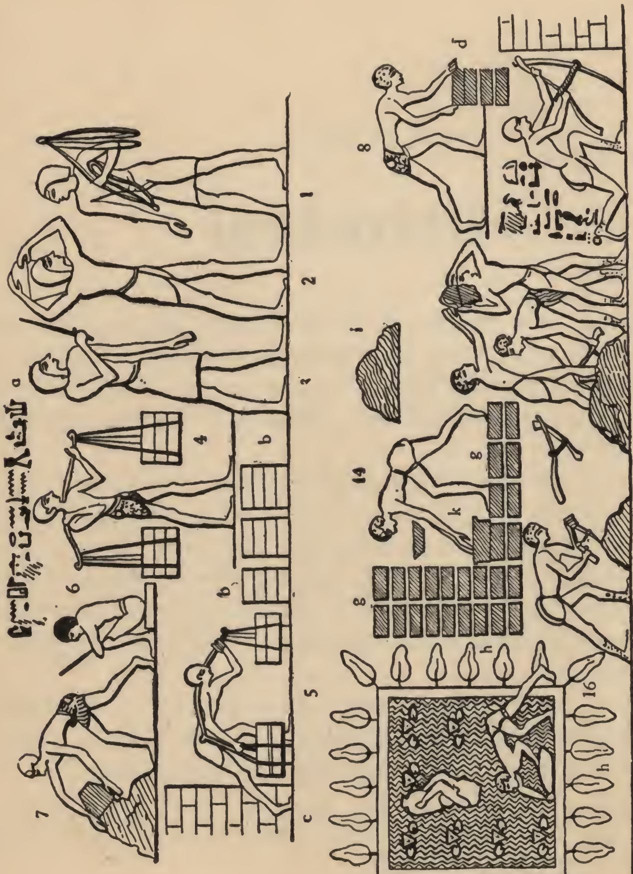
The art of brick making dates from very early times. Sun dried or *adobe* brick were used thousands of years before the earliest recorded date of history, as given on a brick tablet of the time of Sargon of Akkad, 3,800 B.C., founder of the Chaldean empire.

It was very natural for the dwellers along great rivers, such as the Euphrates and Tigris, to notice on the banks the sun baked and irregularly cracked clay blocks which, after a little crude shaping, proved suitable for building a wall. Later, and about the time the Tower of Babel was built, the Chaldeans learned to burn brick, thus converting the clay into a hard substance.

In the time of Nebuchadnezzar (604-562 B.C.), the Babylonians and Assyrians had acquired the art not only of making hard burned brick but of beautifully enameling them.

The Chinese claim great antiquity for their clay industries, but it is probable that the knowledge of brick making travelled eastward from Babylonia across the whole of Asia.

The Great Wall of China was constructed partly of brick, both burnt and unburnt. This was, however, built at a comparatively late period (210 B.C.) and there is nothing to show that the Chinese had any knowledge of burnt brick when the art flourished in Babylonia.



FIGS. 3,771 and 3,772.—Foreign captives employed in making brick at Thebes. 1, man returning after carrying the brick; 7, 9, 11, 13, digging and mixing the clay or mud; 16, fetching water from tank *h*; 3, 6, tank masters; 4, 5, men carrying brick; 8, 14, making brick with a wooden mould *d*, *k*; at *e*, the brick (*tobi*) are said to be made at Thebes.

Sun dried bricks or "adobes" are still made, as in ancient times, on the banks of the Nile by the following method:

A shallow pit or bed is prepared, into which are thrown the mud, chopped straw and water in suitable proportions, and the whole mass is tramped on until it is thoroughly mixed and of the proper consistency. The mixture is removed in lumps and shaped into bricks, in moulds or by hand, the brick being simply sun dried.

In England, the great fire of 1666 transformed London from a wooden to a brick town and gave a great spur to the brick industry.

FIG. 3,773.—Twelfth century church at Cremona, Italy.

The first brick buildings in America were erected on Manhattan Island in the year 1633 by a governor of the Dutch West India Co. The bricks for these buildings were made in Holland, where the industry had long reached great excellency. For many years brick were imported into America from Holland and also from England.

In America burnt brick were first made at New

England about 1650, and the manufacture slowly spread through the New England states.

The Colonial days produced five types of brick architecture from New England to Virginia.

In the nineteenth century up to about 1880, American brick building was largely confined to the use of common brick for ordinary construction or for backing stone faced walls. From that date up to the present a growing taste has demanded and secured artistic effect in the brick wall by the use of specially selected or manufactured brick of various shades and finish.

FIG. 3.774.—Brickwork in old Persian tomb at Ardcbil.

CHAPTER 62

Brick Clays

By definition, clay is *a common earth of various colors, compact and brittle when dry, but plastic and tenacious when wet.* It is a hydrous aluminum silicate generally mixed with powdered feldspar, quartz, sand, iron oxides and various other minerals.

The various kinds of clay are named for their suitableness to a particular use, a brick clay, fire clay, potter's clay, etc.

All clays are the result of the denudation and decomposition of feldspathic and siliceous rocks, and consist of fine insoluble particles which have been carried in suspension in water and deposited in geologic basins according to their specific gravity and degree of fineness.

These deposits have been formed in all geologic epochs from the recent to the Cambrian and they vary in hardness from the soft and plastic alluvial clays to the hard and rock like shales and slates of the older formations.

The alluvial and drift clays which were alone used for brick making until modern times, are found near the surface, are readily worked, and require little preparation, whereas the older sedimentary deposits are often difficult to work and necessitate the use of heavy machinery. These older shales or rocky clays may be brought into plastic condition by long weathering, that is, by exposure to rain, frost and sun, or by crushing and grinding in water; they then resemble ordinary alluvial clays in every respect.

The clays or earth used in modern brick making may be

divided into two classes according to chemical composition, as

1. Clays or shales containing only a small percentage of carbonate of lime.

2. Clays containing a considerable percentage of carbonate of lime.

The first mentioned class consists chiefly of hydrated aluminum silicates which is the true clay substance. Clays of this class usually burn to a buff, salmon or red color.

The second class known as *marls*, may contain as much as 40% of chalk. They burn to a sulphur yellow color which is quite distinctive.

The color of brick depends on the composition of the material and the manner in which it is treated in the kiln.

The chief colorant is the iron oxide in the clay, which does not show until the material has been heated, and which cannot be determined from an inspection of the raw material. This should be remembered because brick makers often speak of clays as red clay, white clay, etc., according to the color of the brick made from them, without any reference to their color in the unburned state.

The strongest brick clays, or those possessing the greatest plasticity and tensile strength, are usually those which contain the highest percentage of the hydrated aluminum silicates.

All clays contain more or less of undecomposed feldspar. The most important ingredient after the clay substance and the sand, is oxide of iron for the color and to a less extent for hardness and durability.

A clay containing from 5 to 8% of oxide of iron will, under ordinary conditions of firing, produce a red brick, but if the clay contain 3 to 4% of alkalies or the brick be fired too hard, the color will be darker, approaching purple. Fenugenous clays generally become darker as they approach the fusion point. Alumina acts to make the color lighter.

So far it has not been found possible to produce a plastic clay from artificially formed materials as the conditions under which plasticity is produced are not known. However, as clay particles are extremely small, it is thought that their plasticity may, in part, be due to the very small distances between them.

On heating sufficiently all clays lose their plasticity and cannot regain it, so that, on burning, they are converted into rigid bodies. Thus, when a clay is heated, the first effect is to drive off the *water of formation.*

The clay then becomes dry, but is not chemically changed; it does not cease to be plastic when cooled and moistened. On continuing to raise the temperature the chemically combined water is separated and the clay undergoes a molecular change, which prevents it taking up water again, except mechanically.

With the loss of the chemically combined water, clay ceases to be plastic, On further heating, clays tend to undergo partial fusion. When this has occurred to a sufficient extent for the fused material to fill the pores completely, the brick becomes impervious to water and is said to be *vitrified.*

The varieties of clays used in brick making are very numerous. Of these may be mentioned:

1. White burning clays.

   Composed chiefly of alumina, silver and water and used to a very limited extent in brick making as cheaper materials are available.

2. Marls.

   These earths contain a considerable proportion of lime in the form of chalk or limestone. Brick made from these are almost white, but this is not due to the purity of the material, but to the combination of the iron oxide with the lime in the clay. Marls are easily fusible and give a characteristic effervescence when a little hydrochloric acid is found upon them.

3. Loams.

   Consist of clays containing a large proportion of sand, rendering them easier to work than tougher clays.

4. Shales.

   These underrated clays have been subjected to so much compression that they are almost semi-rocks in characteristics. They

have little plasticity. Red burning materials obtained from impure shales are largely employed in brick making.

5. Fire clays.

These are the refractory clays, or those capable of resisting very high temperatures in furnaces. They are accordingly used for making fire brick which are employed in lining boilers and other furnaces.

6. Boulder clays.

Glacial action produces these clays, and they are distinguished from other clays by the number of rounded stones they contain. With careful selection and preparation boulder clays make satisfactory common brick.

In addition to the foregoing classes, there are other designations of clays such as:

1. Brick earth.

The term brick earth is used to distinguish clays which can be made into brick without much mechanical treatment from the harder rock clays and shales which must first be ground. Accordingly the machinery necessary to manufacture brick from brick earth is reduced to a minimum.

2. Fat clays.

Those which are strong or plastic; they always contain a high percentage of *true clay substance*, and low percentage of sand. Such clays take up a considerable amount of water in tempering, dry slowly, shrink considerably, and become liable to lose their shape and develop cracks in drying and firing. Fat clays are improved by the addition of coarse sharp sand, making the brick more rigid during the firing.

Impurities.—The presence of organic matter gives wet clay a greater plasticity. In some of the coal measure shales the amount of organic matter is considerable, which renders the

clay useless for brick making. Other impurities, which frequently occur are the sulphates of lime and magnesia, the chlorides and nitrates of soda and potash, and iron pyrites. All of these except the pyrites are soluble in water and are undesirable, as they give rise to *scum* which produces patchy color and pitted surfaces. The commonest soluble impurity is calcium sulphate, which produces a whitish scum on the brick surface in drying, and as the scum becomes permanently fixed in burning, such brick are of inferior quality.

NOTE.—The lime clays or "marls" which contain essentially a high percentage of chalk or limestone, are not so widely distributed as the ordinary brick clays, and in England the natural deposits of these clays have been largely exhausted. A very fine chalk clay or "malm" as it was locally called, was formerly obtained from the alluvium in the vicinity of London; but the valuable supply of this has been used up, and at the present time an artificial "malm" is prepared by mixing an ordinary brick clay with ground chalk. For the best London facing bricks the clay and chalk are mixed in water. The chalk is ground on grinding pans, and the clay is mixed with water and worked about until the mixture has the consistence of cream. The mixture of these "pulps" is run through a grating or coarse sieve on to a drying kiln or "bed" where it is allowed to stand until stiff enough to walk on. A layer of fine ashes is then spread over the clay, and the mass is turned over and mixed by spade, and tempered by the addition of water. In other districts, where clays containing limestone are used, the marl is mixed with water on a wash pan and the resulting creamy fluid passed through coarse sieves on to a drying bed. If necessary, coarse sand is added to the clay in the wash pan, and such addition is often advisable because the washed clays are generally very fine in grain. Another method of treating these marls, when they are in the plastic condition, is to squeeze them by machinery through iron gratings, which arrest and remove the pebbles. In other cases the marl is passed through a grinding mill having a solid bottom and heavy iron rollers, by which means the limestone pebbles are crushed sufficiently and mixed through the whole mass. The removal of limestone pebbles from the clay is of great importance, as during the firing they would be converted into quicklime, which has a tendency to shatter the brick on exposure to the weather. These marls (which usually contain from 15 to 30% of calcium carbonate) burn to a yellow color, which is quite distinctive, although in some cases where the percentage of limestone is very high, over 40%, the color is grey or a very pale buff. The action of lime in bleaching the ferric oxide and producing a yellow instead of a red brick, has not been thoroughly investigated, but it seems probable that some compound is produced between the lime and the oxide of iron, or between these two oxides, and the free silica, entirely different from that produced by oxide of iron in the absence of lime. Such marls require a harder fire than the ordinary brick clays in order to bring about the reaction between the lime and the other ingredients. Magnesia may replace lime to some extent in such marls, but the firing temperature must be higher when magnesia is present. Marls usually contract very little, if at all, in the burning, and generally produce a strong, square brick of fine texture and good color. When underfired, marl bricks are very liable to disintegrate under the action of the weather, and great care must be exercised in burning them at a sufficiently high temperature.

Scumming.—This is an important item in the manufacture of first class brick. When a clay containing calcium sulphate must be used, a certain percentage of barium carbonate is usually added to the wet clay. This converts the calcium sulphate into calcium carbonate which is insoluble in water, so that it remains distributed throughout the mass of the brick instead of being deposited on the surface.

NOTE.—Alkalies is a term used to comprise various compounds of potash and soda occurring in varying, but usually small, quantities in clays. They are powerful fluxes, causing in combination with the silica, alumina and lime in the clay, the formation of very easily fusible compounds which, if formed in sufficient quantity, may cause the collapse of the bricks. These combinations usually take the form of glass, the chief characteristic of which is the vitreous fracture. When such glasses are formed with any oxides of earthly bases also present, they assume crystalline or porcellaneous textures when cooled. It is for this reason that clays which are required to resist high temperature must not contain more than a very small proportion of alkalies or lime compounds. Some of this glassy material is essential for the production of the strongest bricks.

NOTE.—Porcelain, earthenware and hard brick (such as the Staffordshire or Flintshire blue bricks) consist in substance of such glasses, diffused throughout their substance uniformly, and binding together the finely-diffused particles of the excess of fluxes which are present, or binding together the fragments of uniformly-diffused clay, silica (sand ground flint), etc. The degree of fusibility, or of partial fusibility (agglutination) of any hard-baked brick thus depends not only upon the chemical nature of the constituents of the clay, but upon the proportions in which these are present.

NOTE.—It is a curious fact that although mixtures of the various constituents of clay are extremely fusible, yet any one of them heated alone is practically infusible. Thus, lime and silica heated separately cannot be fused in an ordinary kiln, but if mixed in suitable proportions a glass can be formed at a moderate temperature.

CHAPTER 63

Brick Making

In the making, or manufacture of brick, they are hardened after moulding to proper size, by

1. Baking in the sun, or
2. Burning in a kiln.

Hardening by burning is now the universal method. There are numerous methods employed in brick making and the machinery used has been highly developed and specialized. Bricks made of tempered clay may be made

1. By hand, or
2. By machine.

Bricks are now practically always made by machines run by mechanical power. Bricks made of semi-plastic clay (*i.e.* ground clay or shale sufficiently damp to adhere under pressure) are generally machine made throughout.

Methods of Brick Making.—There are four distinct methods employed in the manufacture of brick, the equipment required depending largely upon the nature of the raw material and to some extent upon the desires of the manufacturer. The methods are:

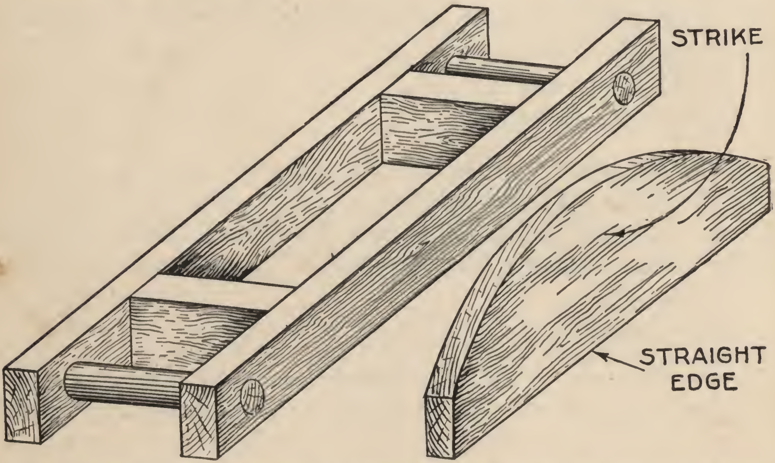
1. Hand method.
2. Soft mud method (obsolete).

3. Dry press method.
4. Stiff mud method.

Hand Method.—This method is used only in isolated or exceptional cases, usually on a very small scale, where labor is very cheap.

In this process the clay is taken directly from the clay bank and thrown into a pit with the proper amount of water.

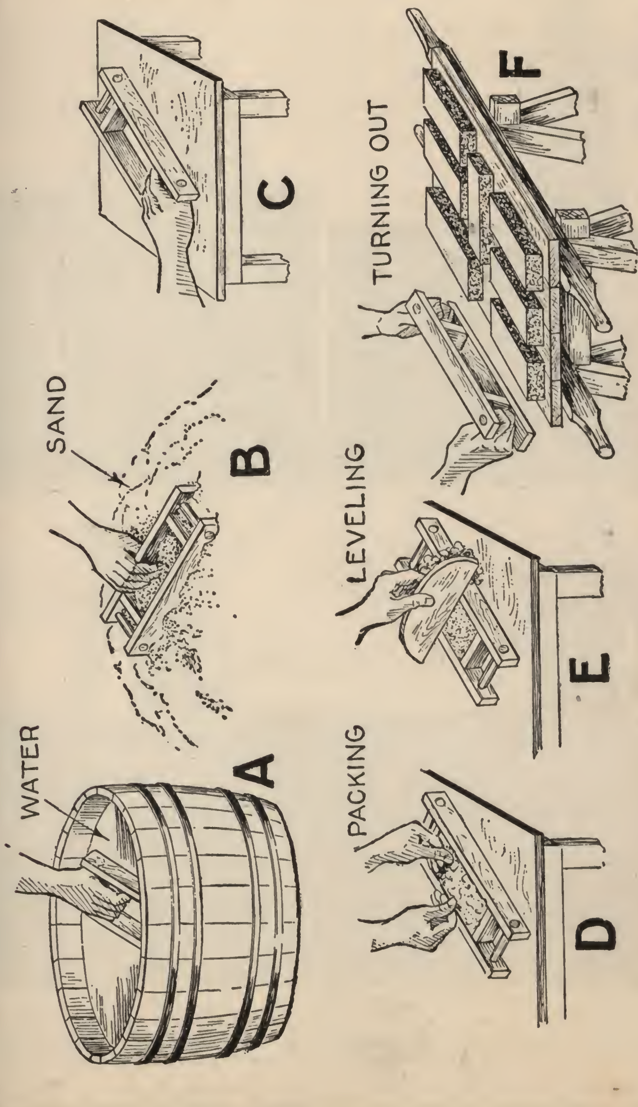
A large wheel operating on a shaft and drawn by a horse or several laborers passes through this pit and thoroughly mixes the clay and water.



FIGS. 3,775 and 3,776.—Home-made brick mould for single brick, and strike. The mould as seen has neither top nor bottom. The strike is simply a short board having a straight edge for levelling off the clay in the mould.

The tempered clay is pressed by hand into a wooden or metal mould or four sided case (without top or bottom) which is of the desired shape and size, allowance being made for the shrinkage of the brick in drying and firing.

Fig. 3,775 shows the mould; the method of using is shown in figs. 3,777 to 3,782. As here illustrated, the moulder stands at the bench or table, dips the mould in water, or water and then sand, to prevent the clay sticking, takes a rudely shaped piece of clay from an assistant, and dashes



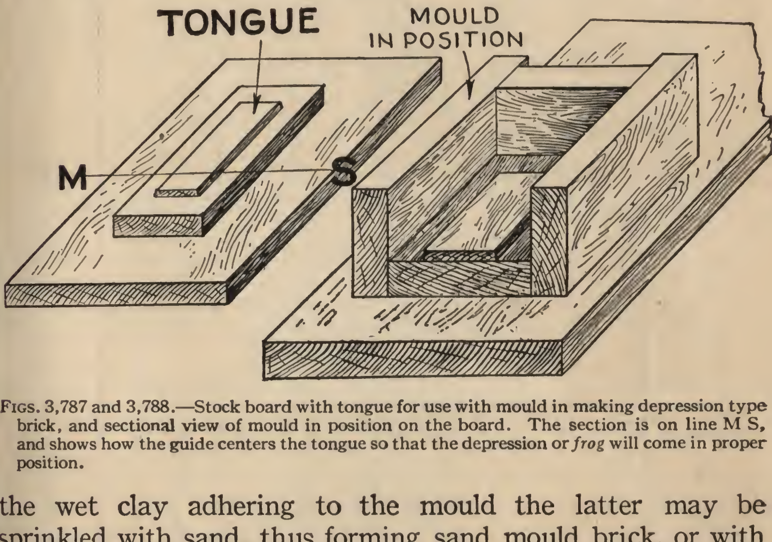
FIGS. 3,777 to 3,782.—Making brick by hand. **A**, wetting the mould; **B**, sanding the mould; **C**, placing mould on table; **D**, packing clay in mould; **E**, levelling with strike; **F**, turning out brick on board.

FIGS. 3,783 to 3,786.—Raber and Lang hand mould for concrete brick, illustrating method of use. Fig. 3,783, filling mould with material; fig. 3,784, tamping with shovel; fig. 3,785; rocking over; fig. 3,786, releasing finished brick. Average time to make 6 bricks, 36 seconds.

this into the mould which rests on the moulding bench. He then presses the clay into the corners of the mould with his fingers, scrapes off any surplus clay and levels the top by means of a strip of wood called a "strike," and then turns the brick out of the mould on a board, to be carried away by another assistant to the drying ground.

The mould may be placed on a special piece of wood, called the stock board, provided with an elevated tongue of wood in the center, which produces the hollow or "frog" in the bottom of the brick.

Soft Mud Method.—This process is simply a method of forming the brick in a mould under pressure. To prevent

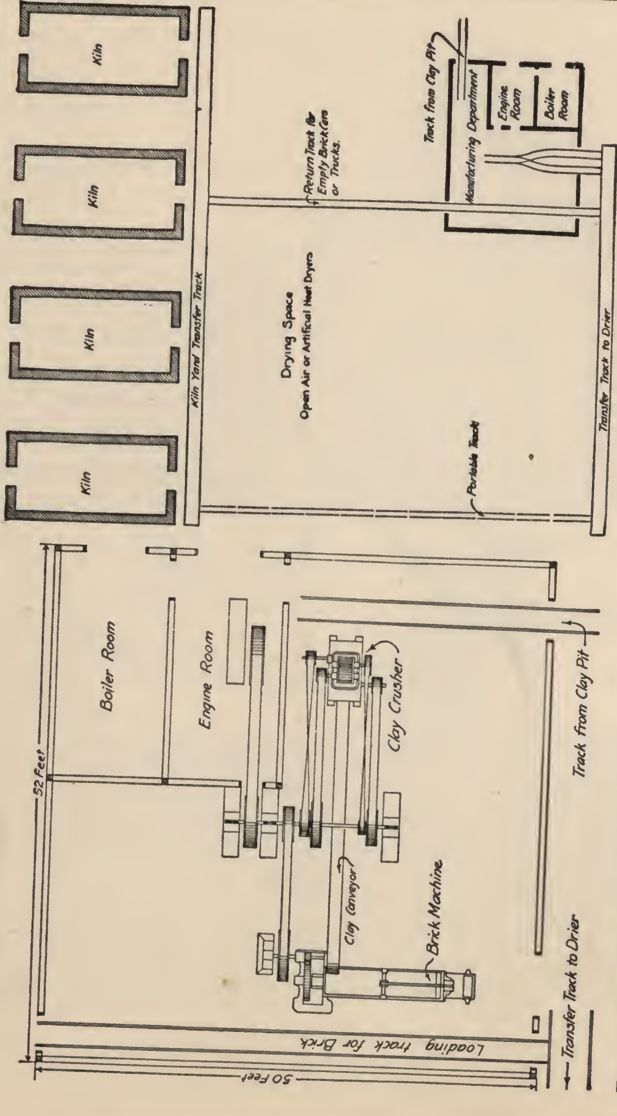


FIGS. 3,787 and 3,788.—Stock board with tongue for use with mould in making depression type brick, and sectional view of mould in position on the board. The section is on line M S, and shows how the guide centers the tongue so that the depression or *frog* will come in proper position.

the wet clay adhering to the mould the latter may be sprinkled with sand, thus forming sand mould brick, or with water, forming water struck brick.

A *disintegrator* is, or is not needed, depending upon the kind of clay which is being used. The clay is thrown into a *soft mud machine* with enough water to bring it to about the consistency of clay that is used for making brick by hand. The *brick machine* thoroughly mixes it up, and presses it into moulds, which are then overturned on a pallet board and the brick carried away to be dried.

In some cases where a greater amount of pugging is desired or required,



FIGS. 3,789 and 3,790.—International soft mud plant. Fig. 3,789, machinery layout; fig. 3,790, yard plan.

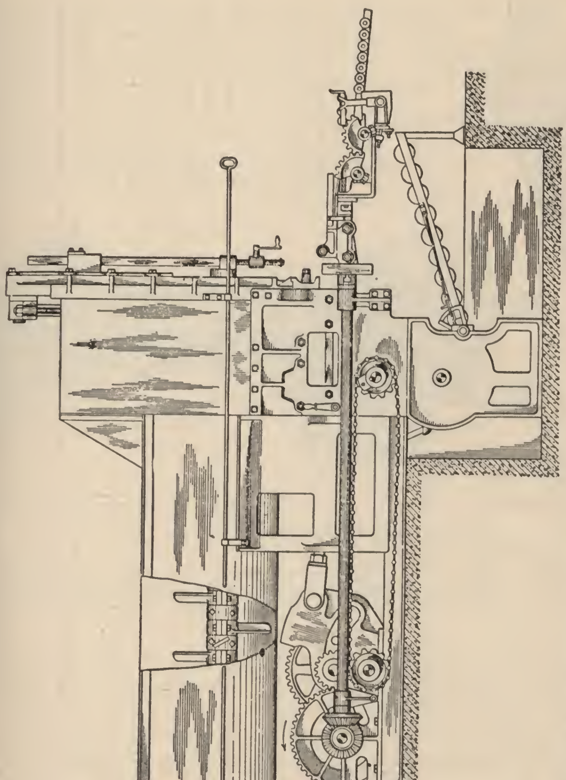
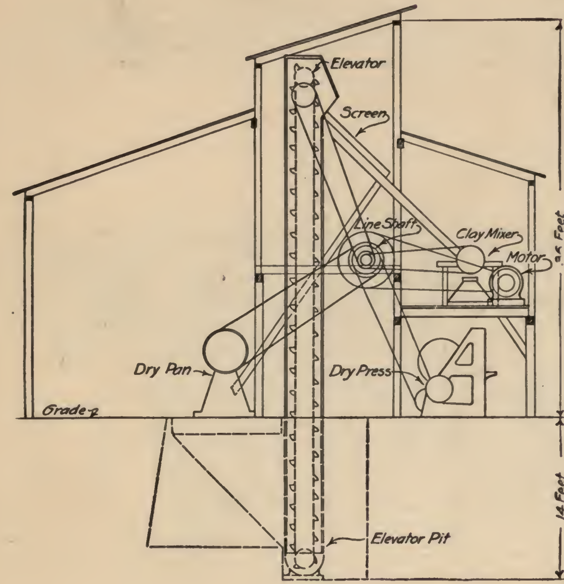
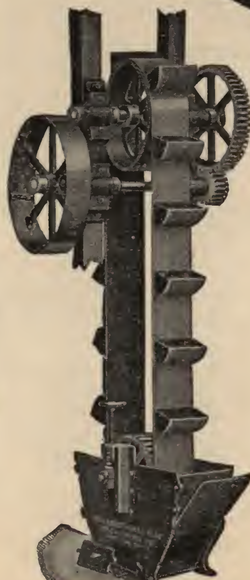


FIG. 3,791.—Lancaster special automatic brick machine for making brick by the soft mud process. ***In operation***, it tempers and presses the clay into the moulds, striking off the surplus clay as the mould comes from under the die and keeping the strikings in the machine. It will then bump the moulds and dump the brick on a pallet, deliver the pallet of brick to trucks or on to a cable conveyor. It puts the empty mould into the sander, where it is properly sanded and then delivered to the machine to be refilled. The only hand work necessary is delivering the pallets to the machine.



Section



FIGS. 3,792 to 3,795.—International elevator and conveyor. The different machines in a brick plant are installed at different levels, for economical handling of the material. Elevators are used to elevate the raw material after breaking up and grinding. The elevator will transfer the fine ground material from the grinding pan to the screens. The screens are installed at a higher level to discharge the screened material into bins or direct into the mixing and tempering machines. Conveyors are used to transport ground soft clays from the disintegrator to the pug mill for mixing and tempering. Ground soft clays are not required to be screened and are ready for mixing and tempering when leaving the disintegrator.

the clay is first put through a pug mill before dropping into the brick machine proper. The soft mud machine can mould four, five or six brick in one operation, depending upon their size. The brick formed by this process are all uniform in size and resemble very much brick made by the hand process.

Dry Press Method.—This method is generally used where it is found that the clay cracks very easily on drying, if too much water be added to it.

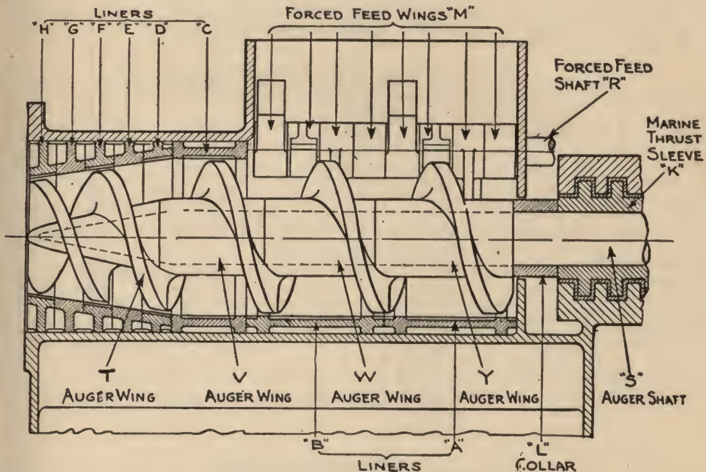


FIG. 3,796.—International auger and liner detail showing tapered auger.

The clay is ground, usually in a dry pan, and then taken directly to the machine, no water being added to it. This machine is a very heavy press and under an enormous pressure it presses the clay into a brick.

Brick made by this process are characterized by being very dense and having very smooth surfaces and sharp corners. *Dry press machines* are usually made in two sizes, to discharge either two or four brick, that is, finished brick at one operation.

No dryer is required by this process, as the brick are taken directly from the pressing machine to the kilns.

Stiff Mud Method.—In this process the ground clay is mixed thoroughly in a pug mill or in a wet pan, from which it is put directly into an auger machine where it receives further mixing and tempering.

By means of a screw arrangement this machine forces the clay through a die located at the front out of which it comes in a continuous bar. Different dies can be constructed, so that the brick will come out with holes

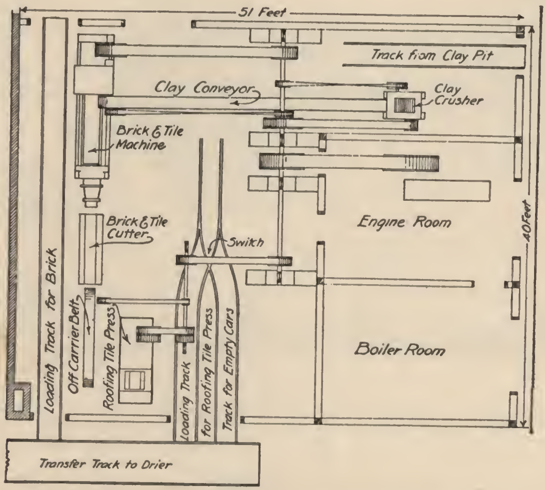


FIG. 3,797.—Stiff mud plant. The yard plan is the same as in fig. 3,790.

in them, or so that round drain tile, hollow-ware, etc., of different sizes can be made.

After the bar of clay comes out of the die, it is now ready to be cut into the proper lengths, which is done on a specially designed cutting table equipped with cutting wires. These wires leave a rough side where they pass through, but as this is usually on the side of the brick where the mortar joint occurs when the bricks are set in the wall, it is not objectionable.

If desired, however, the brick can be put through a repress, which can be operated either by hand or power, which gives the brick smooth faces

and corners and at the same time impresses names or designs in them, if desired.

The stiff mud method is used also for the manufacture of drainage tile, hollow-ware, the simple form of floor tile and roofing tile. The die at the front of the machine determines the kind of ware that can be made.

Brick Making Machinery.—Great progress has been made in brick making by the development of special machinery for performing the different operations which formerly were done by hand. The machines usually employed in making brick are

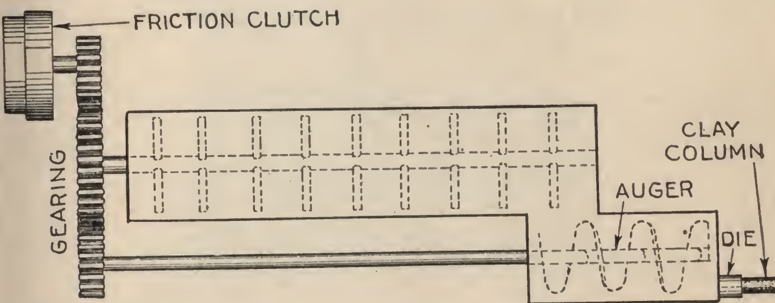


FIG. 3,798.—Elementary auger brick machine, illustrating operation.

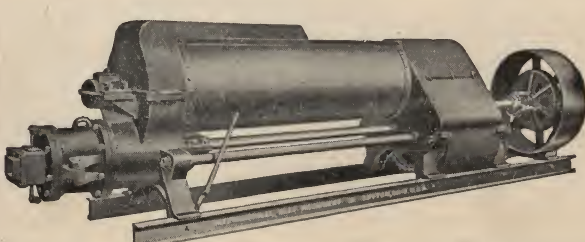


FIG. 3,799.—International stiff mud machine *It consists of* a combined pug mill and brick machine. The upper part of the machine is a long tub with blades which mixes and tempers the material. The lower part has an auger which forces the tempered material through the die and discharges a solid bar of clay to be wire cut in making wire cut brick. This machine is also used in the manufacture of hollow tilc, drain pipes, etc.

1. Disintegrator.
    - *a*. Grinder.
    - *b*. Crusher.
    - *c*. Stone separator.
2. Pug mill.
3. Wire cutter.
4. Press.
5. Brick machine.
6. Drier.

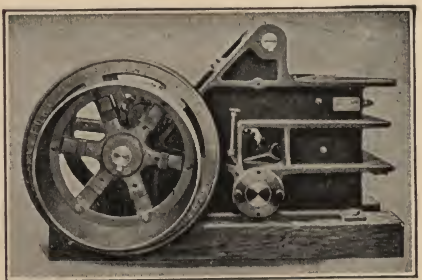


FIG. 3,800.—International rock crusher, for breaking up large lumps and rocks of flint, limestone, sandstone and shale. This crusher will reduce the material to uniform pieces of about the size of eggs.

Disintegrator.—This consists of a grinder of a type best suited to the material used. The grinding mills are either a series of rollers with graduated spaces between, through which the clay or shale is passed, or are of the ordinary "mortar pan" type, having a solid or perforated iron bottom on which the clay or shale is crushed by heavy rollers. Shales are sometimes passed through a grinding mill before they are exposed to the action of the weather, as the disintegration of the hard lumps of shale greatly accelerates the "weathering." In the case of ordinary brick clay, in the plastic condition, grinding

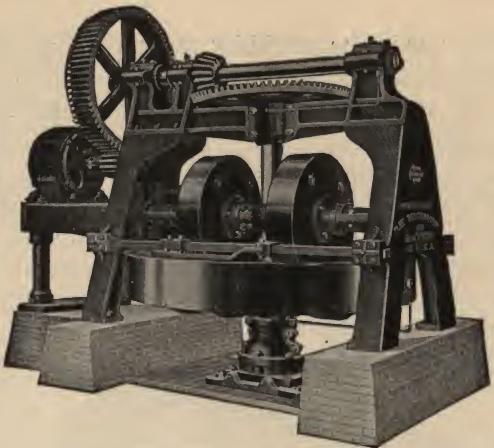


FIG. 3,801.—International grinding or dry pan for reducing flint shale, fire clay, and other hard clays to the proper fineness for the manufacture of clay products. ***In construction,*** the bottom of the pan is perforated and as fast as the clay is reduced to proper size it falls through, ready to be screened and mixed.

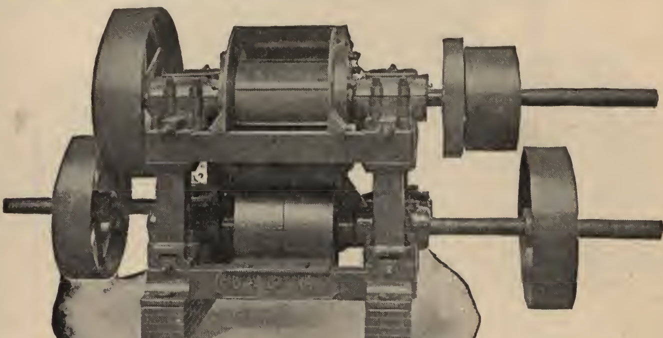


FIG. 3,802.—Lancaster compound disintegrator and crusher. The upper or cutting roll is sectional, fitted with steel cutting bars with flange that overlaps the smooth feeding roll so as to prevent spilling the clay from the side of the machine. ***In operation,*** the upper rolls disintegrate the clay and the lower smooth rolls refine the clay to a uniform disintegration, especially taking care of the disintegration of the fine stones which may pass between the upper disintegrating roll and its smooth feed roll, due to the space occupied by the smooth cutting bars.

mills are only used when pebbles more than a quarter of an inch in diameter are present, as otherwise the clay may be passed directly through the pug mill, a process which may be repeated if necessary.

For wet or alluvial clays, or for general wet grinding, a smooth roll differential crusher is suitable.

For clays containing stones a combined conical roll crusher and stone separator should be used. The term disintegrator as usually applied means

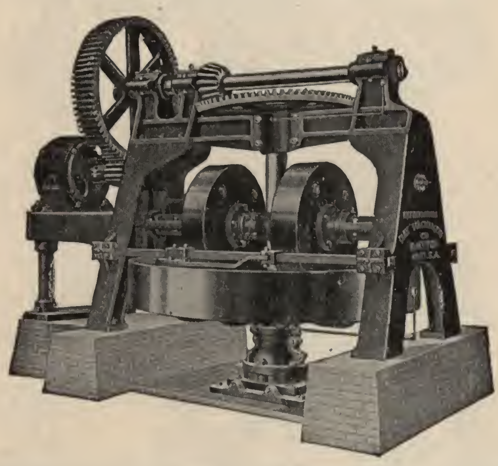


FIG. 3,803.—International wet pan for use where clays must be especially well mixed with water. Suitable for sewer pipe work, fire brick, silica brick, and magnesite brick. ***In construction,*** the wet pan has a solid bottom. ***In operation,*** the material is charged into the pan, where it is properly mixed and ground to the desired fineness, then water is added and the contents are mixed and tempered until ready for the shaping of the brick. This process is very much used in the manufacture of fire brick.

a heavy duty or first stage crusher as distinguished from a second stage crushing machine commonly called a crusher. In fig. 3,802 both machines are combined in one unit and the distinction is clearly shown.

In the stone separating crusher conical rolls differentially geared are provided, the stones being discharged over the large end of the rolls and may be caught in a box or carried away by means of a chute.

Pug Mill.—After the clay has been ground in the disintegrator and crusher, and the stones (if any) separated, it passes into the pug mill.

This machine consists of a box or trough having a feed hole at one end and a delivery hole or nose at the other end, and provided with a central shaft which carries knives and cutters so arranged that when the shaft revolves, they cut and knead the clay, and at the same time force it to-

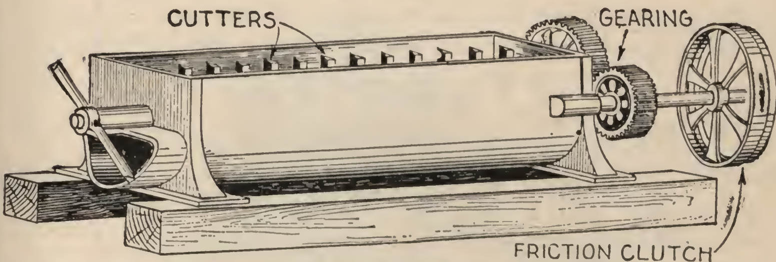


Fig. 3,804.—Elementary pug mill, illustrating operation.

Fig. 3,805.—International pug mill (also called pugging or mixing machine). Some varieties of soft ground clays are of such composition that they can go from the disintegrator direct to the brick machine, others should be pugged until in a soft, plastic state, ready for shaping. Ground material, like clay, shale, and fire clay, must be mixed with water and pugged until plastic and ready for the shaping of the brick.

wards and through the delivery nose, as shown in fig. 3,804, delivering a solid or continuous mass of clay.

The cross section of this nose of the pug mill is usually approximately the same as that of the required brick plus contraction for ordinary bricks.

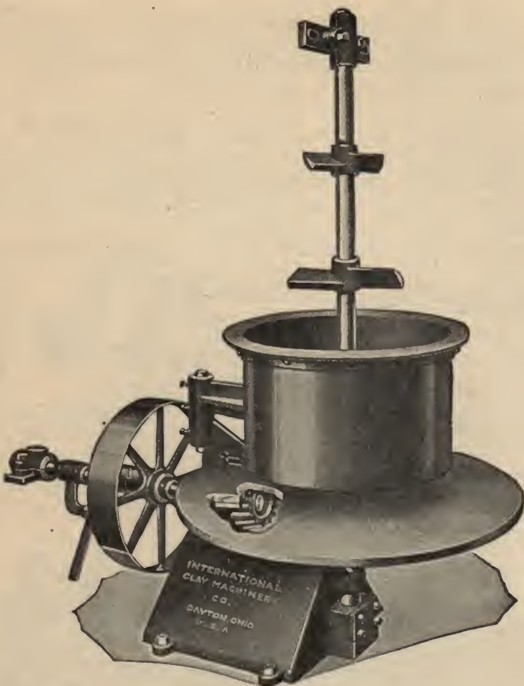


FIG. 3,806.—International automatic feeder for automatically feeding clay into the pug mill. ***In operation,*** the ground clay is dropped into the tub of the feeder from which it is fed into the pug mill through an opening whose size can be adjusted. A uniform mixing of clay and water is secured by adjusting the opening and water supply.

FIG. 3,807.—International auger machine, for use in connection with a pug mill. ***In operation,*** the auger of the machine forces the tempered clay through the die and discharges a solid bar of clay.

Wire Cutter.—The solid mass of clay coming from the auger type pug mill is pushed onto a smooth iron plate, which is provided with a wire cutting frame having a number of tightly stretched wires placed at certain distances apart, arranged so that they can be brought down upon, and through, the clay, and so many bricks cut off at intervals.

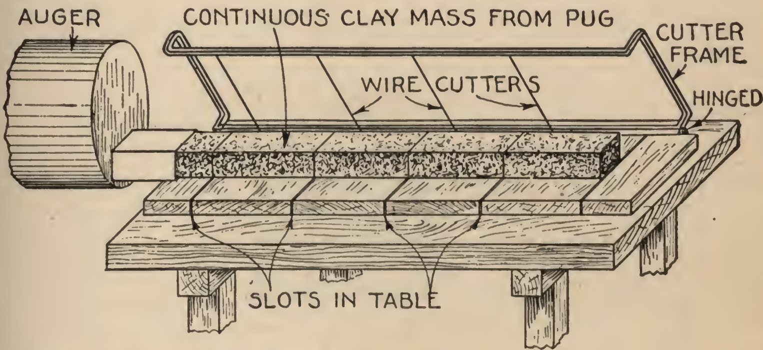


FIG. 3,8C8.—Elementary wire cutter, illustrating operation.

FIG. 38,09.—International wire cutter or board delivery cutting table. *It operates* by hand; cutting into brick the bar of clay formed by the stiff mud pug mill.

The frame is sometimes in the form of a skeleton cylinder, the wires being arranged radially (or the wires may be replaced by metal discs); but in all cases brick thus made are known as "wire cut brick."

According to the section cut, the brick are said to be side cut or end cut.

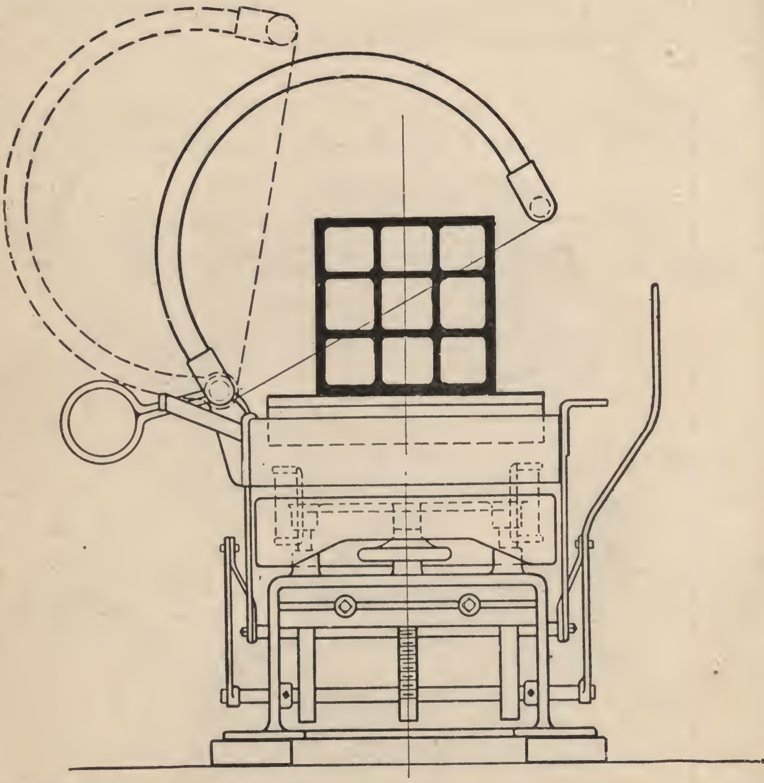


FIG. 3,810.—Freese hollow ware cutter; cross section showing wire movement. ***It will cut*** a clay column of any size up to 14×14 ins. The cutter carriage travels with the clay column while the cut is being made, the carriage being returned to its position neat the machine die by means of the hand lever or foot treadle if preferred. ***In operation,*** the wires enter the corner, passing through the clay column with a shearing movement and leaving smoother edges and better walls than with the type of cutter which carries the wires from side to side or from the top straight downward, striking the walls of the column broadside.

Press.—In order to obtain a better shaped and more compact brick, after the wire cutting process just described the brick are placed in a brick press and then squeezed into iron moulds under great pressure.

Figs. 3,812 and 3,813 show the construction of a typical brick press.

There are many forms of brick press, a few for hand power,

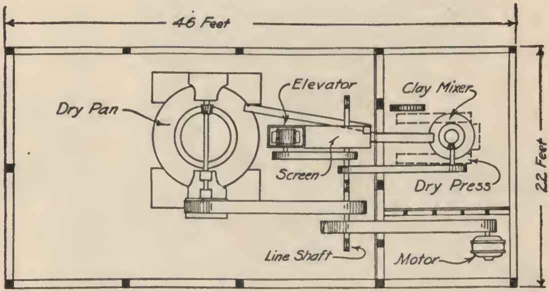


FIG. 3,811.—Dry press plant. Plan showing general arrangement of machinery and space required.

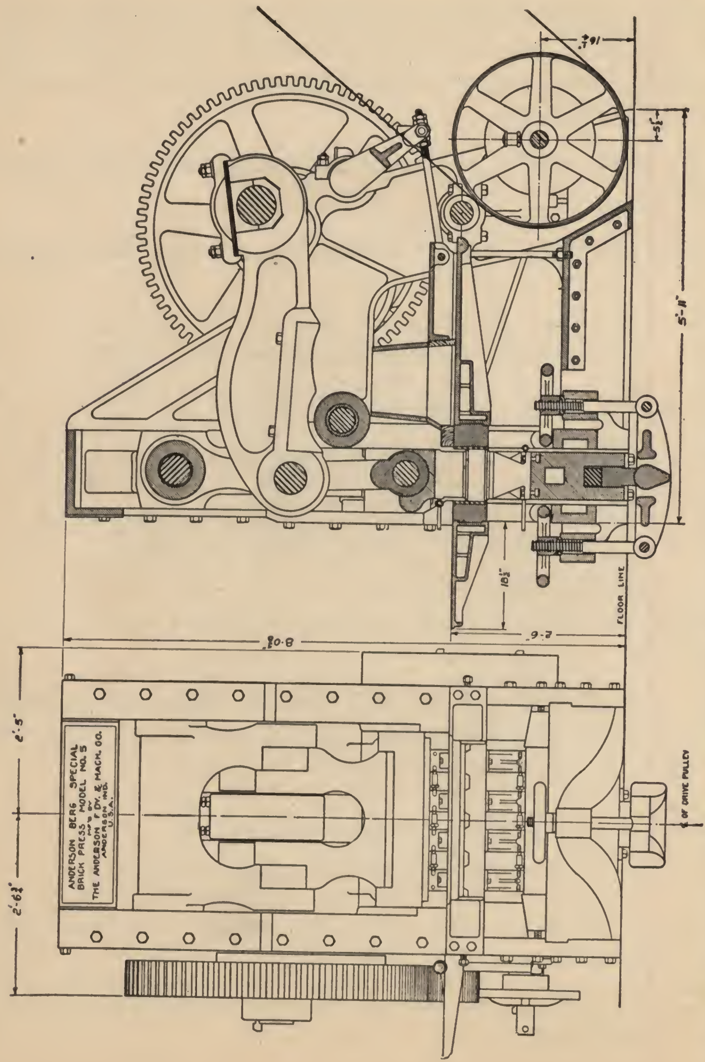
but the most adapted for belt driving, although in recent years hydraulic presses have come more and more into use, especially in Germany and America.

The essential parts of a brick press are:

1. A box or frame in which the clay is moulded.

2. A plunger or die carried on the end of a ram, which gives the necessary pressure

3. An arrangement for pushing the pressed brick out of the moulding box.



FIGS. 3,812 and 3,813.—Anderson-Berg brick press; end and side views, showing construction.

Such presses are generally made of iron throughout, although other metals are used occasionally for the moulds and dies. The greatest variations found in brick presses are in the means adopted for actuating the ram; and many ingenious mechanical devices have been applied to this end, each claiming some particular advantage over its predecessors. In many

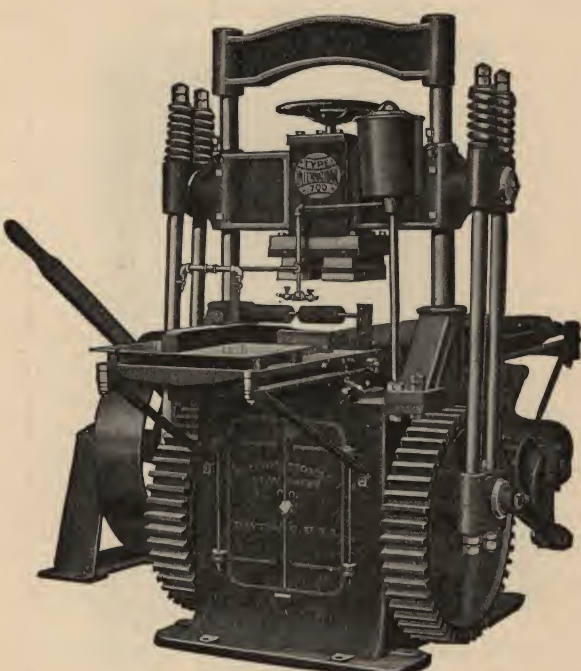


FIG. 3,814.—International automatic repress. ***In the manufacture*** of brick by the stiff mud process, the sides cut by the wire are rough and when the bricks are required to have smooth sides, they are repressed on a repress machine. The same press is used to stamp names and patterns on bricks, also for corners and special sharp edges. The repress is also used for floor tiles.

recent presses, especially where semi-plastic clay is used, the brick is pressed simultaneously from top and bottom, a second ram, working upwards from beneath, giving the additional pressure.

Brick Machine.—The operations performed by the pug mill, cutter, and brick press are now generally done by one machine called a brick machine which is simply a pug mill, cutter, and brick press combined.

In operation the pug delivers the clay, downwards into the mould; the

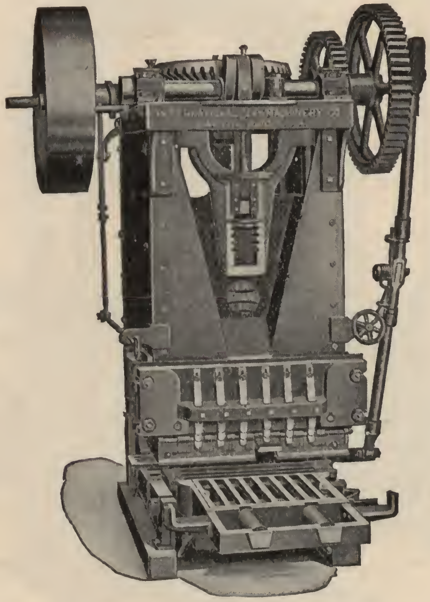


FIG. 3,815.—International soft mud brick machine. ***In operation,*** the mixed and tempered material is charged into the machine and the blades inside the machine again pug, temper, and force the contents toward the bottom where the material is forced into moulds of proper size. Four to six bricks can be made in one operation. The soft mud process uses material with a high moisture content.

proper amount of clay is cut off; and the mould is made to travel into position under the ram of the press, which squeezes the clay into a solid mass. The general appearance of a brick machine is shown in fig. 3,815.

Drying.—As soon as the clay product has been formed, it

is ready for drying. In older plants very often air drying is resorted to, but in modern plants artificial drying of two general kinds is used, as accomplished by:

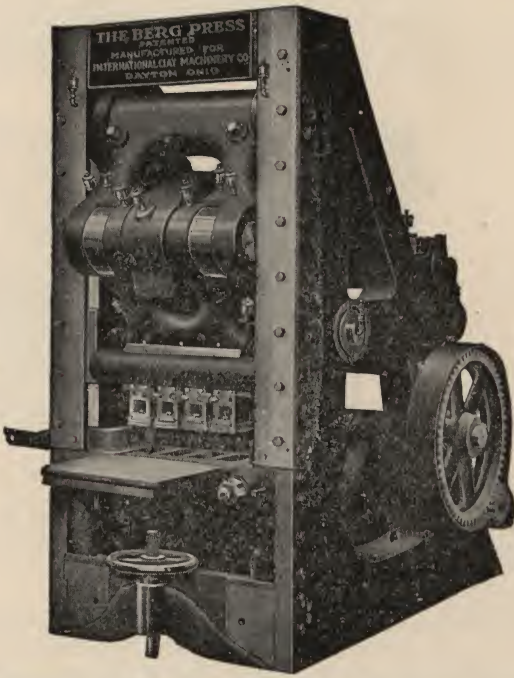


FIG. 3,816.—Berg dry press brick machine. Some clays are of such nature that they will crack in drying if too much water be added to them when forming the brick. In such cases a dry press machine is used, the clay being pressed into a brick under enormous pressure without adding any water. Used to make facing brick, where smooth faces and sharp corners are desired, also for making fire brick.

1. Drying floors.
2. Tunnel dryers.

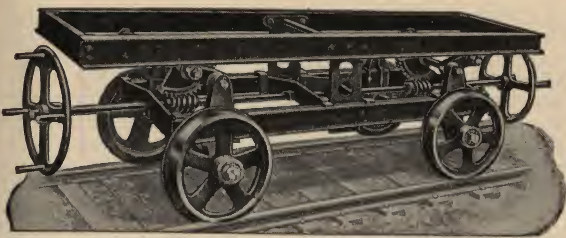
Drying Floor.—This is a concrete, stone, steel, tile or some other kind of floor, under which either steam or heat is used to radiate through and dry the material, which has been deposited on the floor. This method is still considerably used in the drying of special fire clay shapes, and in some cases for drainage tile.

Tunnel Dryers.—Tunnels are long, narrow structures into which loaded cars of wet or green brick or tile are placed and dried until ready for placing in the kilns for burning. The cars loaded with wet brick are set in at one end and the dried brick are drawn out at the other end, each tunnel holding about fifteen cars, so that the process is continuous.

FIG. 3,817.—International clay mixer used to mix clay and feed it to the dry press. It is sometimes fitted with steam coils to put a small amount of moisture into the clay. It feeds the clay into the machine at a constant rate which can be varied to suit conditions.

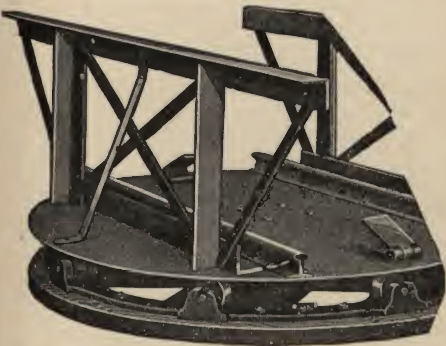
The heat for these is either waste heat for cooling kilns, heat from a furnace burning coal, wood, gas, or oil, or exhaust or live steam heat. The brick remain in the dryer until the water which was added in the tempering of the clay has been eliminated and the brick are hard enough to set in the kiln.

It is important that the brick be properly dried and the proper equipment be metallic for this work. The atmosphere of the drying shed should be fairly dry to which end suitable means of ventilation must be arranged (by fans or otherwise). If the atmosphere be too moist the surface of the brick remains damp for a considerable time, and the moisture from the interior passes to the surface as water, carrying with it the soluble salts,



which are deposited on the surface as the water slowly evaporates. This deposit produces a "scum."

When the drying is done in a dry atmosphere the surface quickly dries and hardens, and the moisture from the interior passes to the surface as vapor, the soluble salts being left distributed through the whole mass, and consequently no "scum" is produced. Plastic brick take much longer to dry than semi-plastic; they shrink more and have a greater tendency to warp or twist.



FIGS. 3,818 and 3,819.—International open-air dryer for sun and air drying, and pallet turn table. The turn table is set near the cutting machine and two pallets are placed thereon. About 500 brick are set on these pallets and elevating car is run underneath and raised. The pallets are taken in that manner to the drying sheds, the bed lowered allowing the brick to set upon permanent pallet rests while the car returns for another load. A second car is used to carry the dried brick to the kiln.

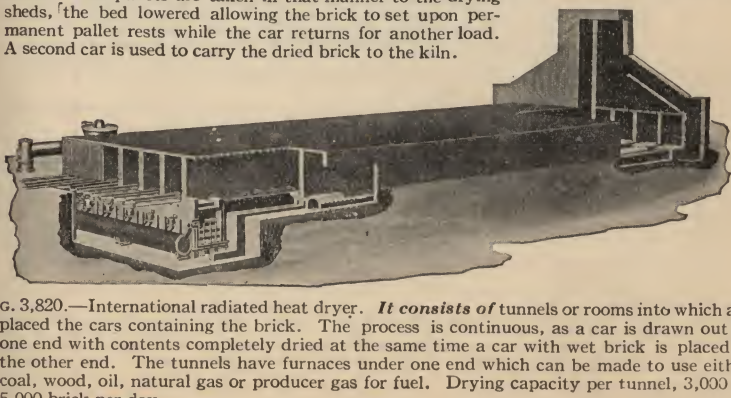


FIG. 3,820.—International radiated heat dryer. ***It consists of*** tunnels or rooms into which are placed the cars containing the brick. The process is continuous, as a car is drawn out at one end with contents completely dried at the same time a car with wet brick is placed in the other end. The tunnels have furnaces under one end which can be made to use either coal, wood, oil, natural gas or producer gas for fuel. Drying capacity per tunnel, 3,000 to 5,000 brick per day.

The best drying clays will permit rapid application of heat, drying the brick safely in six to eight hours.

The average drying clays require that the brick be subjected to moderate heat for several hours, or until the brick have "set" sufficiently to be "free" from the pallets, before the rapid drying heat can be applied, and the brick dried safely in 12 hours, which some consider to be the standard basis of calculation for drying brick in steam pipe rack brick dryers.

Burning.—The burning or firing of bricks is the most im-

FIG. 3,821.—Lancaster "Martin" steam pipe rack brick dryer, showing method of filling racks with aid of conveyor.

portant factor in their production; for their strength and durability depend very largely on the character and degree of the firing to which they have been subjected. The action of the heat brings about certain chemical decompositions and recombinations which entirely alter the physical character of the dry clay. It is important, therefore, that the firing should be carefully conducted and that it should be under proper control.

For ordinary brick, the firing atmosphere should be oxidizing, and the finishing temperature should be adjusted to the nature of the clay, the object being to produce a hard strong brick, of good shape, that will not be too porous and will withstand the action of frost.

The finishing temperature ranges from 900° C. to 1250° C., the usual temperature being about 1050° C. for ordinary bricks. Lime clays require a higher firing temperature (usually about 1100° C. to 1200° C.) in order to bring the lime into chemical combination with the other substances present.

FIG. 3,822.—Sub-section of Lancaster "Martin" steam pipe rack brick dryer. The section is 8 ft. between centers of supporting racks, 14 shelves of pipe in height, 5 ins. center to center of pipes, 9 pallets of brick in width. The sub-section holds 126 six brick pallets of bricks or 756 bricks.

Kilns.—It is evident that the best method of firing bricks is to place them in permanent kilns, but although such kilns were used by the Romans some 2,000 years ago, the older method of firing in "clamps"* is still employed in the smaller brickfields in every country where bricks are made.

*NOTE.—These clamps are formed by arranging the unfired bricks in a series of rows or

Kilns are of three general types:

1. Up draft.
2. Down draft.
3. Continuous kilns.

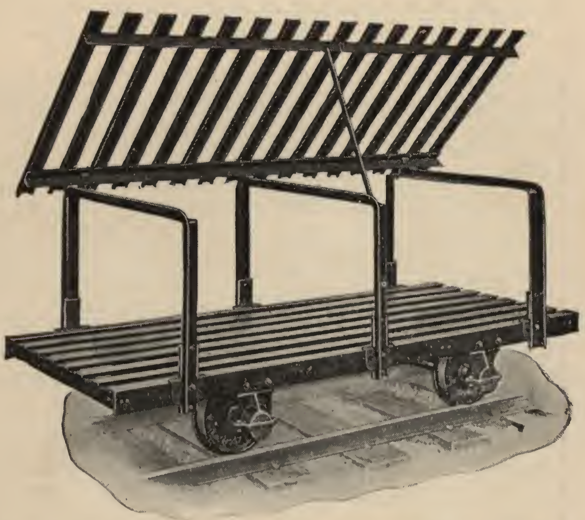


FIG. 3,823.—International dryer car. ***It has*** steel decks and three uprights, used to carry brick drainage tile, and hollow brick.

NOTE.—*Continued.*

walls, placed fairly closely together, so as to form a rectangular stack. A certain numbe of channels, or fire mouths are formed in the bottom of the clamp; and fine coal is spread in horizontal layers between the bricks during the building up of the stack. Fires are kindled in the fire mouths, and the clamp is allowed to go on burning until the fuel is consumed through- out. The clamp is then allowed to cool, after which it is taken down, and the bricks sorted, those that are under fired being built up again in the next clamp for refiring. Sometimes the clamp takes the form of a temporary kiln, the outside being built of burnt bricks which are plastered over with clay, and the fire mouths being larger and more carefully formed. There are many other local modifications in the manner of building up the clamps, all with the object of producing a large percentage of well fired bricks. Clamp firing is slow, and also uneco nomical, because irregular and not sufficiently under control; and it is now only employed where bricks are made on a small scale.

Up Draft Kilns.—This style of kiln is the cheapest to build. These kilns are of two general kinds:

1, Permanent wall type;
2, Temporary wall type.

FIG. 3,824.—Up draft kiln, as used for burning lower grades of brick.

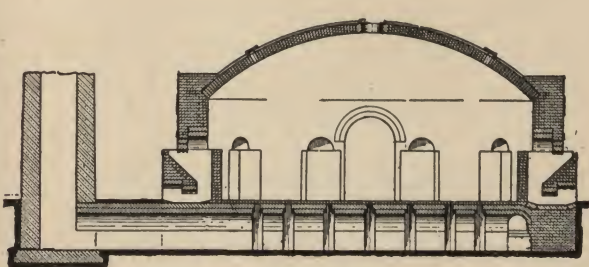


FIG. 3,825.—Round down draft kiln for burning high class ware such as facing brick, roofing tile, fire brick, and sewer pipe.

In the first style the brick to be burned are set between the walls in such a manner as to allow openings along the bottom at intervals, in which coal or wood is used. In kilns without permanent walls, the entire kiln is built up of brick to be burned, leaving fire boxes at intervals. Then the entire kiln is mudded over the sides to make it air tight.

In all up draught kilns the heat travels from the bottom and upward and escapes through the top. Coal, wood, or gas can be used for fuel.

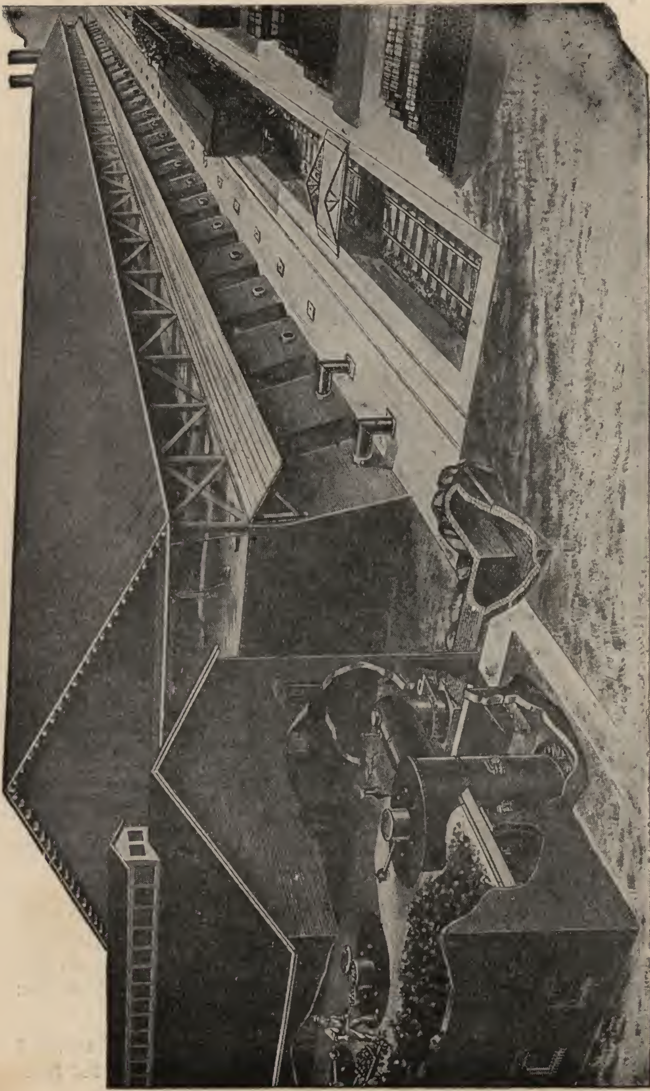


FIG. 3,826.—International continuous kiln. ***These kilns*** use less fuel than other types, but are more expensive to build, they being fitted especially for the larger plants. They consist of a series of chambers, the air of combustion being heated up by passing it through chambers filled with hot, burned brick. The burning gases instead of passing direct to the stack are first pulled through chambers of green brick, thus practically burning these brick before any direct heat is turned into them. Continuous kilns are used for the burning of brick, tile, hollow ware, and fire brick. Fuel used, fine coal fired direct, or producer gas made from coal.

Building brick, drain tile, and floor tile can be burned in this type of kiln although, in the case of tiling it is necessary to have kilns with permanent walls.

Down Draft Kilns.—These are permanent installations and can be built either rectangular or round. They have permanent walls and a permanent top. The bottoms are perforated, which perforation connects with a flue, and this in turn with the stack.

The heat which is supplied either by wood, coal, oil, or gas, travels upward along the inside of the kiln, then downward through the ware into the flue at the bottom of the kiln and out into the stack. The down draft type of kiln is used for better grades of product and where a higher temperature is required.

Continuous Kilns.—In later years the continuous kilns have been developed. These kilns are either direct fired with coal, or with producer gas.

This type of kiln consists of a number of chambers immediately adjacent to each other, so that the heat after passing through one chamber is carried to the next, the next, and so on, so that all of the heat is extracted from the gases before they finally pass up the stack.

Average Burning Temperatures.—Common building brick, drain tile, and hollow-ware, 1,700 degrees Fahrenheit, 925 degrees Centigrade, to 2,000 degrees Fahrenheit, 1,095 degrees Centigrade.

Roofing tile and floor tile, sewer pipe, 1,800 degrees Fahrenheit, 970 degrees Centigrade, to 2,200 degrees Fahrenheit, 1,205 degrees Centigrade.

Fire brick and fire clay products, 2,000 degrees Fahrenheit, 1,095 degrees Centigrade, to 2,500 degrees Fahrenheit, 1,370 degrees Centigrade.

Silica and magnesite brick, 2,700 degrees Fahrenheit, 1,480 degrees Centigrade, to 3,000 degrees Fahrenheit, 1,650 degrees Centigrade.

In each of the above cases the average limits are given as different clays require different temperatures for burning.

NOTE.—***Fire brick.*** These can be by either the soft mud or dry press plants as shown in figs. 3,789 and 3,790, also 3,811 with the exception that a dry pan is used instead of a disintegrator, as fire clay is nearly always hard. If it be rock-like, a jaw crusher is used to reduce it to a size suitable for dry pans. Special shapes and large block are usually dried on a hot floor, which is a floor made of wood or cement underneath which are placed steam or hot water pipes. Regular brick and shapes made on either a stiff mud or soft mud machine are usually dried in tunnel dryers such as shown in fig. 3,820. Dry press brick contain so little moisture that in most cases a dryer is not used. When one is desired, however, a tunnel dryer is best adapted for it. Rectangular or round down draft kilns, or continuous kilns can be used for burning. Up draft kilns are rarely used as it is difficult to reach the proper temperature in them. Fuel can be either natural or producer gas, coal, or oil.

CHAPTER 64

Brick

By definition, a brick is *a solid unit of clay, either burned or sun dried, about* $8\times3\frac{3}{4}\times2\frac{1}{4}$ *inches in size.*

A portion of a brick as distinguished from the whole is called a *brick bat* or *bat.*

The half of a brick is known as a "$4\frac{1}{2}$ in. bat," and any length above this and below 9 ins., a $\frac{3}{4}$ bat.

The great variety of bricks used in building may be classed:

1. With respect to the degree of heating, as

   a. Sun dried (*adobe*).
   b. Burnt.

2. With respect to hardness, as

   a. Kiln run.

   Embracing all hard enough for the outside of buildings divided into hard, common building, paving, hard building, outside, hard red, strictly hard, select hard, rough hard, hard washed, kiln run hard, and common hard brick.

   b. Soft or salmon brick.

   Embracing those not hard enough for outside walls and including soft salmon, backing up, pale light, chimney, filling in, inside wall and foundry brick.

3. With respect to the color, as

NOTE.—There is more or less confusion in different localities as to exact definitions of the different grades of brick.

a. Red.
b. Yellow.
c. Blue, etc.

4. With respect to method of making, as

a. Hand made (obsolete.)
b. Machine made.

5. With respect to finish, as

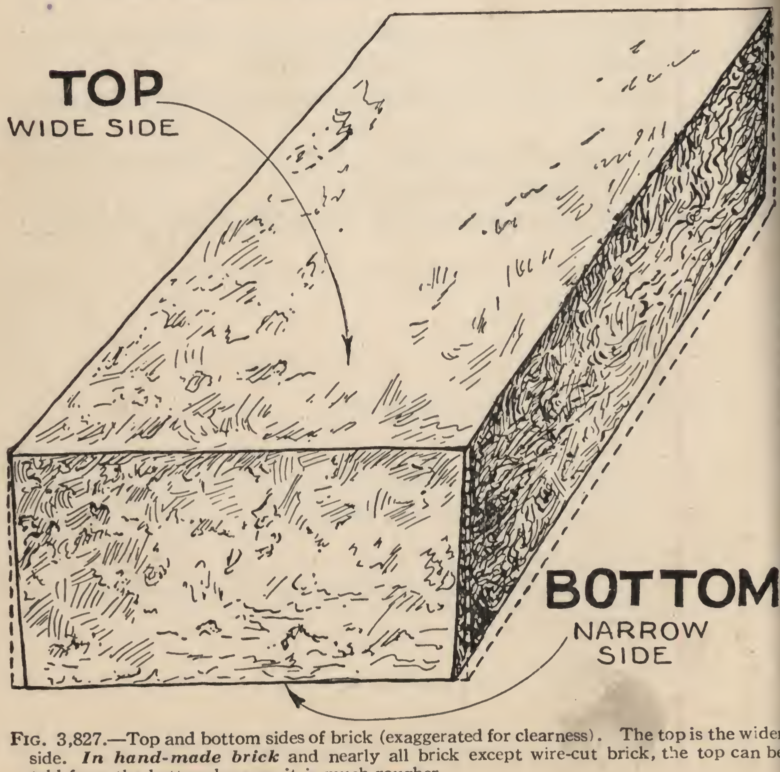
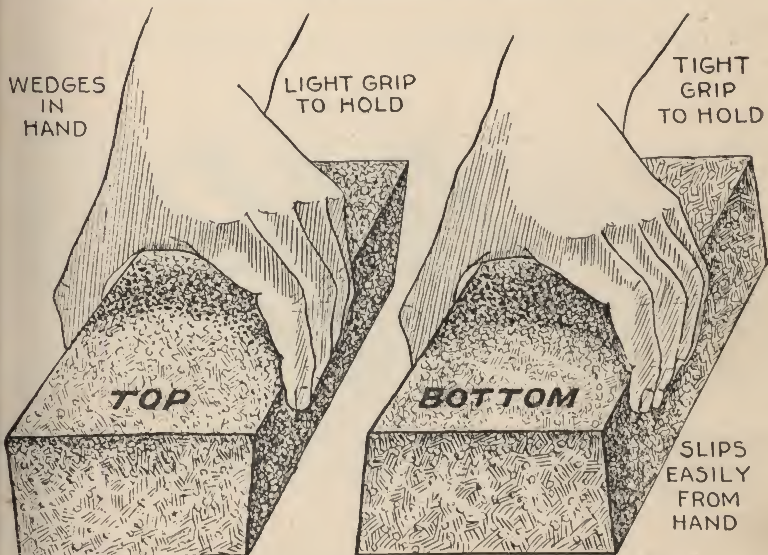


FIG. 3,827.—Top and bottom sides of brick (exaggerated for clearness). The top is the wider side. ***In hand-made brick*** and nearly all brick except wire-cut brick, the top can be told from the bottom because it is much rougher.

a. Common.
b. Face or pressed $\left\{\begin{array}{l}\text{smooth.}\\ \text{rough.}\end{array}\right.$
c. Dressed.
d. Glazed.

6. With respect to disposition of the material, as



Figs. 3,828 and 3,829.—How to distinguish the top from the bottom of a brick. Since the top is wider than the bottom, the brick can be held with less pressure of the fingers on the front and back of the brick, *top up*, as in fig. 3,828, than when *bottom up*, as in fig. 3,829. The very small difference in the width of the top and bottom sides can be detected by this sense of touch. It should be noted that wire cut brick are not wedge shaped.

a. Solid.
b. Hollow.

7. With respect to service, as

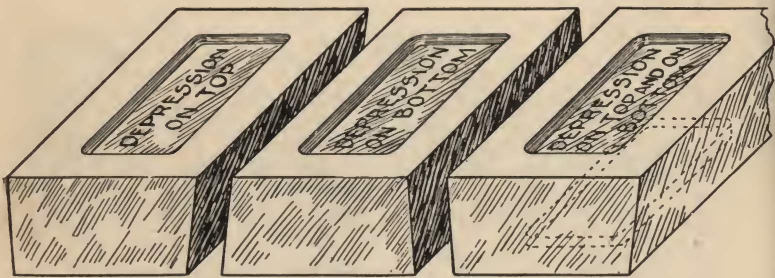
a. Facing.

b. Backing.
c. Paving, etc.

8. With respect to the material, as

a. Clay.
b. Shale.

9. With respect to shape, as



FIGS. 3,830 to 3,832.—Depression type brick. Some bricks are made with a depression which is intended to lock the mortar and make a stronger joint. ***The depression*** is sometimes made on top, sometimes on the bottom, and again on both top and bottom. *The depression should be on top rather than on the bottom.*

a. Common.	*d*. Plinth.
b. Squint quoin.	*e*. Radial.
c. Bull nose.	*f*. Coping.

etc.

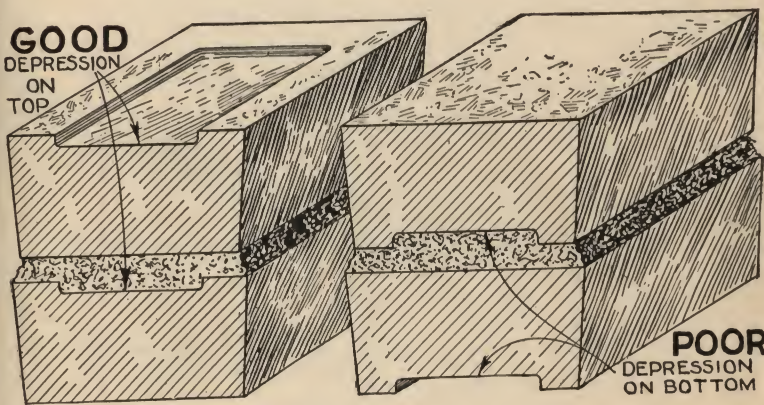
From the classification it is seen that the builder has a great variety of brick to choose from. Some are made for strength and some for appearance. It must accordingly be evident that anyone contemplating giving a contract for a brick building should have a knowledge of the properties of these various brick. Hence, any contract for a brick building

should specify in great detail the quality and kind of brick to be used.

In general the following characteristics should be noted:

Common Brick.—These are made of clay or shale with the usual heat treatment in the kiln. Common brick have a natural surface, in distinction to face brick which have an artificial surface.

Sand Lime Brick.—These brick have a low crushing strength, hence should not be used where strength is essential.



FIGS. 3,833 and 3,834.—Depression type brick. Sectional views showing distribution of the mortar with top and with bottom depressions. Unless the setting be first class, the bottom depression brick are objectionable.

Face Brick.—Since brick of this class are made accurately to size and are finished for appearance (rough or smooth) they are employed for the outside of walls; being accurate to size they can be laid with thin joints without disturbing the bonding.

Pressed Brick.—These are made almost entirely for face work, although in some localities dry pressed brick are used as common brick. Hydraulic pressed brick are dry pressed. Moulded brick are always dry pressed. Very fine brick are made by this process. Dry pressed brick may be obtained artificially colored.

Dressed Brick.—To secure accurate dimensions, bricks are sometimes dressed, that is, rubbed against a cast iron plate, the workman sometimes beating them with a wedge-shaped beater tipped with iron, called a dresser. This treatment toughens the brick, corrects any warping which may have taken place, and leaves the arrises very sharp.

Glazed Brick.—These brick, which are uniform in size, are made in

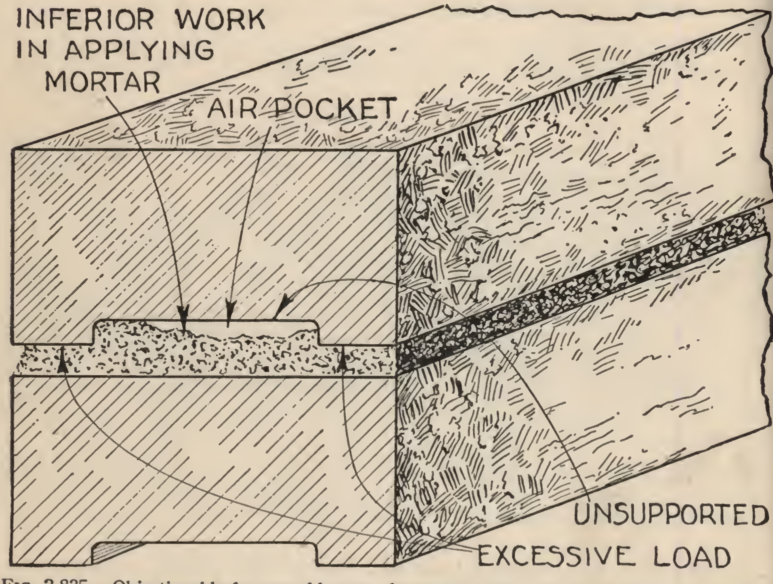


FIG. 3,835.—Objectionable feature of bottom depression brick. Before a bottom depression brick is laid, the depression should be filled with mortar, otherwise air will surely be pocketed in the depression by the mortar which will prevent proper bedding, resulting in unequal loading as shown.

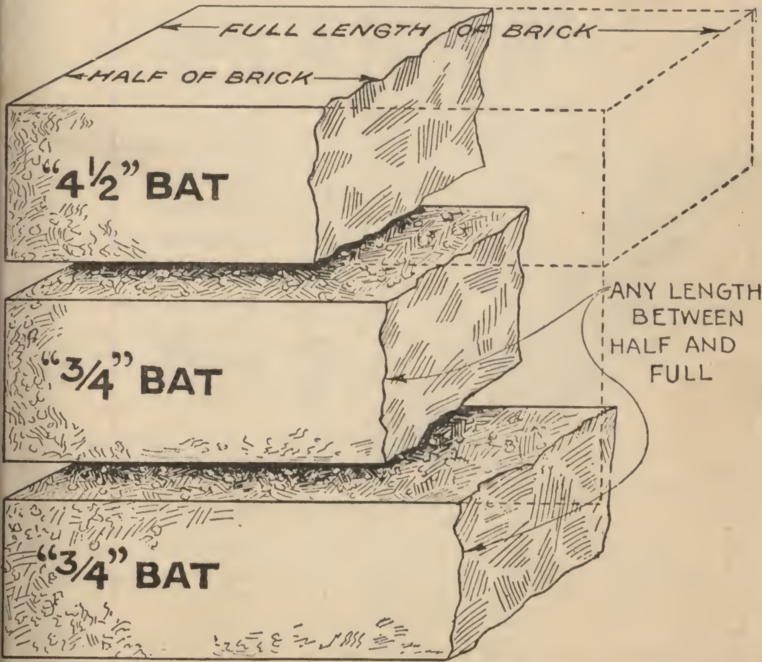
a mould, and later by special treatment receive a glazed surface. They are used to secure sanitation and cleanliness, as in hospitals, kitchens, etc.

Enameled Brick.—The terms *glazed* and *enameled* refer practically to the same product. An enameled surface may be distinguished from a glazed surface by chipping off a piece of the brick. The glazed brick will show the layer of slip between the glaze and the body of the brick, while the enameled brick will show no line of demarcation between the body of the brick and the enamel.

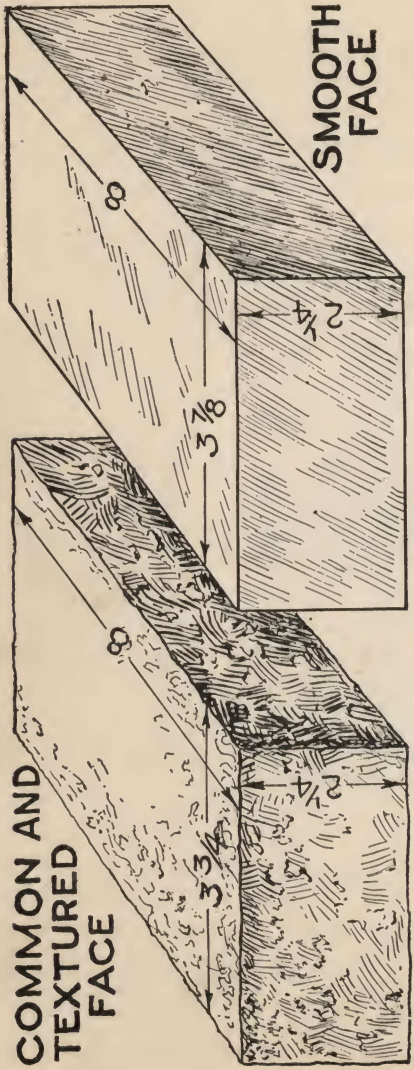
Enameled (as well as glazed) brick are extensively used for the exterior surfaces of buildings, particularly for street fronts and light courts, and for interior side walls and partitions of rooms or buildings used for a great variety of purposes.

Fire Brick.—In manufacture, fire brick are usually made from a mixture of flint clay and plastic clay. They are usually white, or white mixed with brown in color, and are used for the lining of furnaces, fire places and chimneys.

Paving Brick.—These are extremely hard, usually annealed or



FIGS. 3,836 to 3,838.—Brick bats or bats. The half of a brick is known as a 4½ in. bat, as in fig. 3,836; while any length above this and below 9 in. is known as a ¾ bat, as in figs. 3,837 and 3,838. ***With the new standard*** of brick sizes just introduced, which calls for 8 in. length of brick, fig. 3,836 will be correctly called a "4 in. bat"; the ¾ bat designation, though it gives no indication of the size, will no doubt still have to be tolerated, ridiculous as it is.



FIGS. 3,839 and 3,840.—Standard sizes for common and textured face brick and smooth face brick, as adopted by the Department of Commerce representing manufacturers and consumers, June 22, 1923.

vitrified. They are considerably more expensive than common brick and are seldom used in buildings.

In general, brick that are hard burned weather better and are ordinarily put on the outside of the wall. The softer or less burned are used for inside work known as *backing up* and for interior walls. All brick, including soft brick, possess a considerable factor of safety for all loads ordinarily imposed upon them.

Size of Brick.—Up to a few years ago brick were made in a multiplicity of sizes. Some years ago, however, the American Face Brick Association and the Common Brick Manufacturers' Association adopted a standard size for their

product. The American Society for Testing Materials confirmed this standard size and incorporated it in their specification for building brick. Most of the brick now manufactured in the United States conforms to this standard size as follows:

Common brick and textured face brick

8 x 2¼ x 3¾

At the later request of certain manufacturers the following additional standard has been proposed but not yet officially adopted.

Smooth face brick

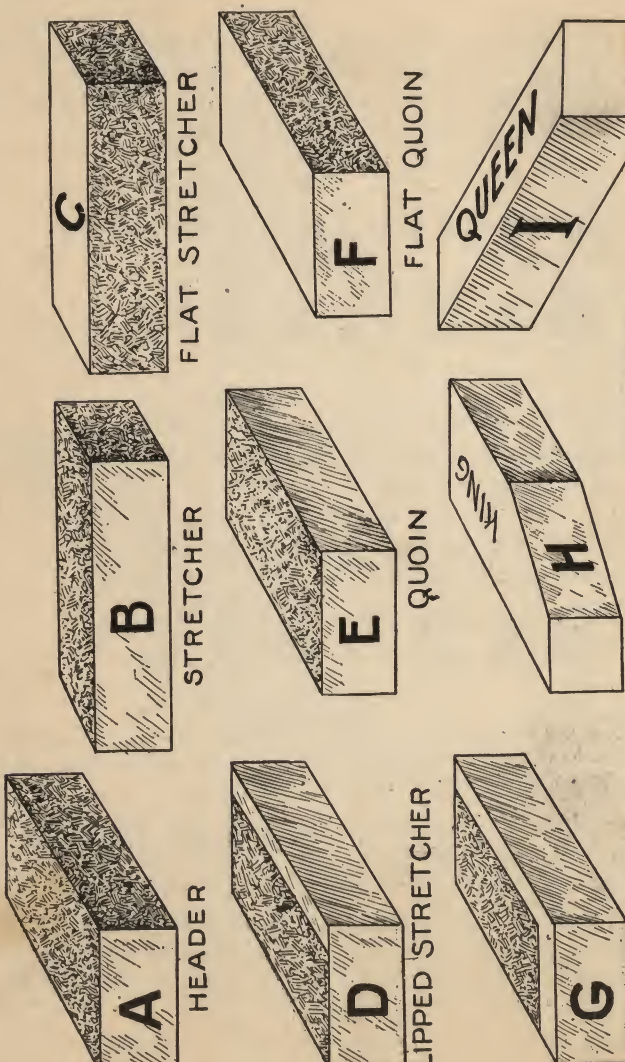
8 x 2¼ x 3⅞

The sizes of all common brick vary considerably in each lot according to the degree to which they were burned, the hard brick being from ⅛ to 3/16 in. smaller than the salmon brick.

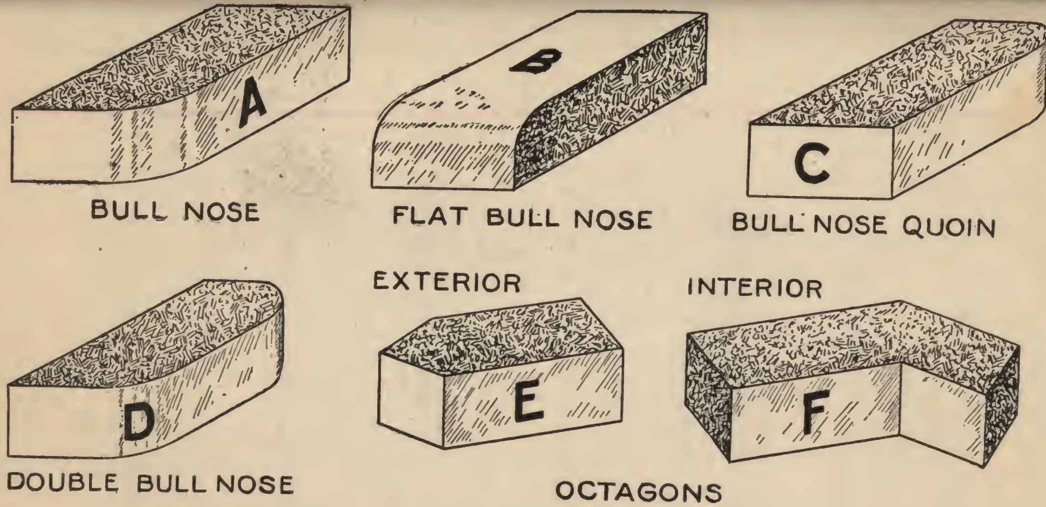
The sizes for pressed brick were $8\frac{3}{8} \times 4\frac{1}{8} \times 2\frac{3}{8}$ and $8\frac{3}{8} \times 4 \times 2\frac{1}{4}$ in. Pressed brick were also made 1½ in. thick and $12 \times 4 \times 1\frac{1}{2}$, those of the latter size being termed Roman brick, or tiles.

While elimination of the great variety of sizes by the new standard will considerably simplify matters for both makers and consumers, it is to be expected that there will be some slight variation for these sizes due to the characteristics of the materials used and mode of manufacture.

Fire brick are made in various sizes (and shapes) to suit the requirements. The ordinary size of fire brick is $9 \times 4\frac{1}{2} \times 2\frac{1}{2}$.

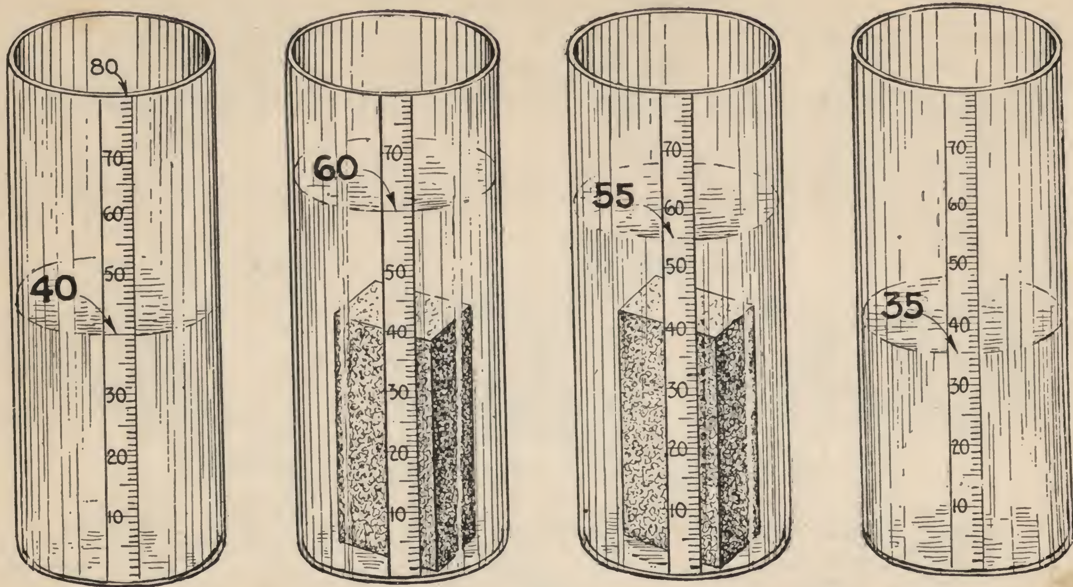


FIGS. 3,841 to 3,849.—Various standard brick forms, *I:* **A**, header; **B**, stretcher; **C**, flat stretcher; **D**, lipped stretcher; **E**, quoin; **F**, flat quoin; **G**, lipped quoin; **H**, king closer; **I**, queen closer.



FIGS. 3,850 to 3,855.—Various standard brick forms, *II:* **A**, bull nose; **B**, flat bull nose; **C**, bull nose quoin; **D**, double bull nose; **E**, exterior octagon; **F**, interior octagon.

Weight of Brick.—This varies considerably with the quality of the material, and with the size of brick. The weight of brick ranges from 4½ lbs. to 5½ lbs. A $9 \times 4\frac{1}{2} \times 2\frac{1}{2}$ fire brick weighs about 7 lbs. In estimating it is convenient to know the weight of brick per cu. ft.; this is given in the following table:



FIGS. 3,856 to 3,859.—Absorption test of brick. ***Provide*** a cylindrical glass vessel barely large enough to hold a brick end up and about twice as high as the brick. Paste a strip of paper vertically on the outside of the glass and mark off the paper with horizontal lines to any equal divisions, such as 1/16 in. and number them. Fill glass tank about half full and note exact height on the paper strip of the water level as 40 in fig. 3,856. Immerse the brick on end and read the height of water, say 60 as in fig. 3,857. Take another reading after brick has stood in the water 24 hours, as 55 in fig. 3,858. Take out the brick and again read the height of the water, as 35 in fig. 3,859. This procedure shows that the brick displaces 20 points of water and absorbs 5 points, or $(5 \div 20)$ of 100% = 25% of its bulk of water. This is considerably in excess of the absorption of the average brick.

Physical Tests.—At least five dry bricks shall be weighed and completely submerged in water at a temperature between 60 and 80° F., the water heated to boiling within one hour, boiled continuously for five hours and then allowed to cool in the water to a temperature between 60 and 80° F. They shall then be removed, the surface water wiped off with a damp cloth and the brick quickly weighed.

The percentage of absorption shall be computed on the dry weight, according to the relation:

$$\text{Percentage of Absorption} = \frac{100\ (B-A)}{A},$$

where A = weight of dry brick and B = weight of saturated brick.

Strength of Brick.—The ratio of the crushing strength of brick and of walls built from them varies with the strength of the brick, the workmanship and character of the mortar joints.

***Classification of Bricks.**—According to the results of physical tests, bricks are classified as vitrified, hard, medium and soft bricks on the basis of the following requirements:

Name of Grade	Absorption Limits, per cent.		Compressive Strength (on edge), lb. per sq. in.		Modulus of Rupture, lb. per sq. in.	
	Mean of 5 Tests	Individual Maximum	Mean of 5 Tests	Individual Minimum	Mean of 5 Tests	Individual Minimum
Vitrified Brick........	5 or less	6.0	5000 or over	4000	1200 or over	800
Hard Brick..........	5 to 12	15.0	3500 or over	2500	600 or over	400
Medium Brick........	12 to 20	24.0	2000 or over	1500	450 or over	300
Soft Brick...........	20 or over	No limit	1000 or over	800	300 or over	200

The standing of any set of bricks is determined by that one of the three requirements in which it is lowest.

Absorption Test.—For the same kind of brick, the one which will absorb the least amount of water is the most desirable.

The reason for this is, because in laying the bricks having a great avidity for water will absorb the water from the mortar so rapidly that the latter

*NOTE.—According to the American Society for Testing Materials official for the various grades of brick.

does not set properly and will crumble in the fingers when dry. Hence before laying, the bricks should be thoroughly dampened.

A test for absorptiveness of a brick as suggested by Gilbreth may easily be made as shown in figs. 3,856 to 3,859. In making the test the brick must be perfectly dry before placing in the water or the test will not be accurate.

Volume of Masonry.—In consequence of the variations in dimensions of bricks, and thickness of the layer of mortar or cement in which they may be laid, it is also impracticable to give any rule of general application for volume of laid brick work. It becomes necessary, therefore, when it is required to ascertain the volume of bricks in masonry, to proceed as follows:

Rule—1. To face dimensions of particular brick used, add thickness of mortar joint.

2. Compute area in sq. ft. and divide this by area of face of wall; ***3.*** Multiply quotient thus obtained by number of rows of brick across wall which will give number of brick in wall.*

Example.—A 12 in. wall is 4 ft. high and 80 ft. long; size of brick $8\times2\frac{1}{4}\times3\frac{3}{4}$; $\frac{1}{2}$ in. joints. How many brick does it contain?

1. face dimen. + joint

$$8 + \tfrac{1}{2} = 8\tfrac{1}{2}$$
$$2\tfrac{1}{4} + \tfrac{1}{2} = 2\tfrac{3}{4}$$

2. face area brick and mortar $\frac{8\frac{1}{2}\times2\frac{3}{4}}{144}=.162$ sq. ft.

face area wall $=4\times80=320$ sq. ft.
No. of brick in face of wall $=320\div162=1975$

3. Number of brick in wall $1{,}975\times3=5{,}925$

*NOTE.—In case of a header row consider header row as two rows.

CHAPTER 65

Mortar

One of the most essential elements in brickwork is the *mortar** in which the bricks are laid.

By definition, mortar is *a cementing material used to bind together brick or stones into structures.*

There are several kinds of mortar, composed of different materials, of different strengths and of cost which varies not only for the mortar itself, but also on the ease of its making.

The principal mortars are:

1. Lime mortar.
2. Lime-cement mortar.
3. Cement mortar.

    a. Portland.
    b. Natural.

Lime mortar is recommended for ordinary house construction. It may be used except where very heavy loads have to

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*NOTE.—***The Greeks** in their masonry construction did so erect their marble walls by rubbing the blocks together after applying sand and water to the joint, until the desired planes were obtained. Thus laid, the large blocks of marble, which were of sufficient size and stability to retain their positions in the wall by gravity, made a perfect wall. With the modern small clay unit of brick, however, there is not sufficient weight to a unit to permit the Greek procedure. ***Here mortar is used,*** and it fulfills the double function of providing for each brick a bed in which the irregularities of surface are overcome and, what is still more important, of surrounding each brick with a bonding material which eventually produces a monolithic structure.

be carried as on brick piers, or walls much cut up by window or door openings, or in very exposed situations.

It should not be used for exterior basement walls subject to a great deal of dampness, because excessive dampness, if long continued, makes it lose its binding properties. Lime mortar hardens slowly and becomes stronger with age. Its cost is low.

Cement-lime mortar has come in favor within the last few years. Tests show it to be stronger in compression and better than Portland cement mortar, when properly proportioned. The suction of the brick, which steals much moisture from Portland cement mortars, affects cement-lime mortars to a less degree when hydrated lime is used. Cement-lime mortar is much less costly than Portland cement mortar.

Portland cement mortar is excellent mortar for more expensive work or where special strength is required, or for wet or very exposed structures, under water, or for freezing weather where there is a chance that the wall may be subjected to alternate freezing and thawing before the mortar has set. It is more costly than other mortars, and for special purposes is rapidly losing ground in favor of cement-lime mortar.

Natural Cement mortars may be used in walls or piers carrying heavy loads, which will not be exposed to dampness for at least one month after being laid. They are generally sold under various trade names, and are not generally so costly as Portland cement mortar. They should not be used in very exposed situations. Natural cement varies greatly in quality and strength.

Lime Mortar.—This kind of mortar is composed of sand and either slaked lump lime or hydrated lime. It is important to know something about the sand and especially the lime.

Sand.—This material is usually obtained from three sources:

1. Pit.
2. River or lake.
3. Sea.

Pit Sand may be angular, rough, and sharp in grit, making it by far the best for mortar. It is sometimes found mixed with clay, rendering it necessary to wash it, as all sand for mortar-making should be thoroughly clean.

River Sand has sometimes the advantage of being clean, but the action of the water may have rounded the grains, making it less valuable for building purposes.

Sea Sand, like the above, is rounded in grain. It has also the disadvantage of being salt, thus absorbing the moisture from the atmosphere and rendering the work damp.

Sand should be clean with sharp angular particles free from vegetable matter, loam, large stones and dust. Pit sand makes the best mortar. If it cannot be obtained, good sand can often be found in river beds. A simple test for cleanliness is to squeeze some wet sand in the hand. If loam be present the sand will retain its shape. If not, it will have a gritty sound and rubbed on the palm, will not leave a slimy deposit. If sand be used containing more than 5 per cent of loam the strength of the mortar will be seriously reduced, and such sand should not be used.

Sand, for all ordinary purposes, need be screened only, so as to remove the large stones. For finer work it must be sifted, and, when necessary, washed to cleanse from dirt, etc., as the latter is most detrimental to mortar making.

Substitutes for Sand.—The mortar mill has given rise to the use of many of these. Thus sandstone or granite chippings form an excellent mortar. Burnt ballast makes what practical men term a greedy or hungry sand, turning out a mortar that sets, but does not adhere to the brick or stone. Broken bricks may also be placed under this heading; while smithy ashes form a first class sand for black mortar.

Lump Lime.—This lime is formed by calcining limestone in kilns. When sold in barrels these contain 180 or 280 pounds net.

In some parts of the country it is customary to sell lump lime by weight or by the bushel, the bushel varying from 75 to 85 pounds net. A cubic foot weighs from 60 to 65 pounds.

It is a good plan to *slake* lump lime directly when it comes on the job, and not store it.

The term "slake" means *to render less strong and active by absorbing something*. Lime is slaked by pouring water on it. Lump lime before it is slaked must be kept dry and prevented absorbing moisture from the atmosphere or it may become useless. If it must be stored, keep it in an air tight box if in bulk, and in a dry covered place if in barrels.

Do not accept lime that is old or air slaked. Fresh lime is in hard lumps with little powder. Air-slaked lime is mostly powder and the lumps are soft and crumbly. Lime should be free from cinders and clinkers. It should be in hard lumps with little dust. When water is added, it should slake quickly into a fine smooth paste without leaving any residue.

Hydrated Lime.—It sometimes happens that lime slaked on the job may, owing to carelessness or lack of skill, be burned or otherwise spoiled.

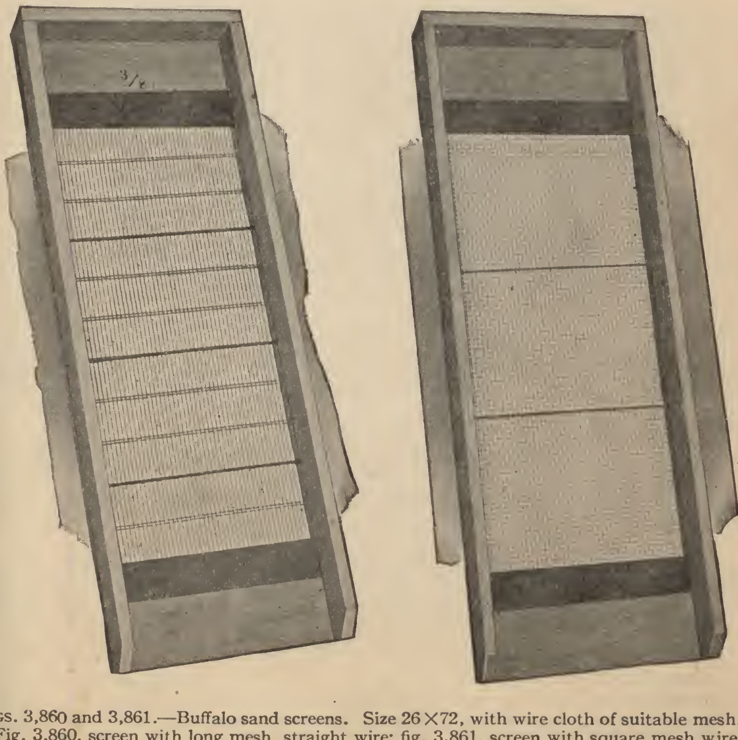
To overcome this difficulty, some lime manufacturers hydrate or slake lime at their plants. Being slaked under factory conditions its quality is uniform. It should be used where experienced labor cannot be had. Mortar made with hydrated lime can be mixed and used immediately. Hydrated lime is in powder form, and comes in paper bags.

Apparatus for Mixing and Handling Mortar—Certain fixtures and tools are necessary for mixing and handling the mortar; they are:

1. Screen.

2. Mortar box.
3. Mortar platform.
4. Hoe.
5. Shovel.
6. Hod.

Screen.—This consists of a frame, usually made of pine, 22



FIGS. 3,860 and 3,861.—Buffalo sand screens. Size 26×72, with wire cloth of suitable mesh. Fig. 3,860, screen with long mesh, straight wire; fig. 3,861, screen with square mesh wire.

ins. wide by 72 ins. long. Wire netting of suitable mesh for screening the sand is attached to the frame, as shown in figs. 3,860 and 3,861.

The wire netting is covered at top and bottom with sheet iron to prevent unnecessary wear at these two points. ⅛ in. is the standard mesh for the wire netting. Figs. 3,863 and 3,864 show a home made screen.

Mortar Box.—In suburban districts the mortar box is usually built on the ground or in the street at the most convenient

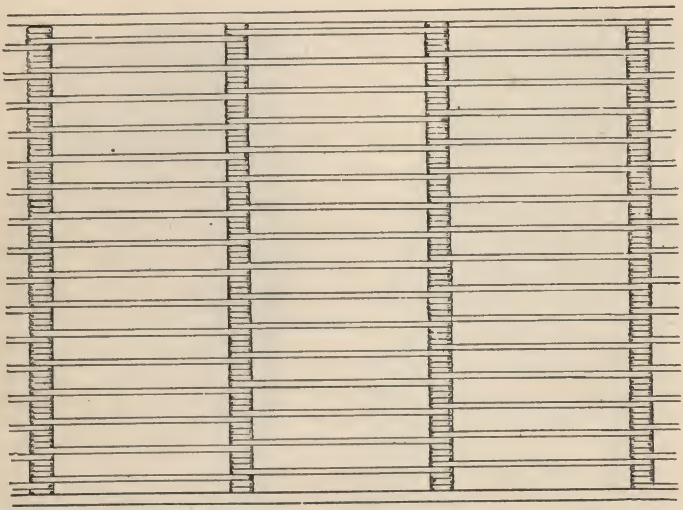


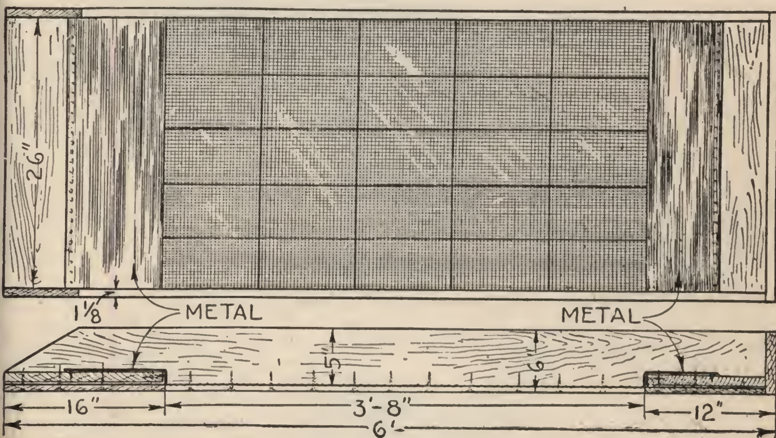
FIG. 3,862.—Buffalo coiled wire for screen, designed for heavy work; used largely on sand dredges.

place for water and use, always careful not to violate ordinances of the community, and securing permits when necessary.

When the ground upon which the box is to rest is level, the bottom boards may be simply laid down and the two sides set up and held by curb and stakes as shown in fig. 3,865; end boards may be set up as shown at one end or banked with sand.

Sometimes a sand bed is necessary to properly support the box. Such bed is generally made by spreading a three or four inch layer of sand on the ground. On this lay three 2″×10″ planks the width of the box. On these planks lay the 2×10 planks forming the floor. The sides and ends of the box (which are permanently nailed together) should then be placed on the bottom and the corners and any holes in the bottom plastered with mortar. A box of this kind being made of several pieces is easily taken from one job to another.

Fig. 3,865 shows a box of this kind. A platform for the stacked mortar is shown adjacent to the box. In city work where mixing has to be done in the building, a tight box is necessary.



FIGS. 3,863 and 3,864.—Home-made sand screen. Pine is the best wood to use. Fir and cypress make a good substitute for the frame or body. For a good job no lighter than 1⅛″ lumber should be used. The top and bottom back is sometimes covered or partly covered with sheet metal, tin is suitable. It saves the wood from the heavy wear and causes damp sand to slip off more readily when shoveled against it. No. 10 gauge, is a good standard for screening. It is stronger when reinforced at intervals with a heavier gauge wire. When more fine screening is required than may be conveniently done with hand screen or riddle, the same screen may be used by placing a No. 12, 14, or 16 screen wire inside over screen temporarily. Painting the wood before and after put together much increases its life. Any depth frame may be used. The depth shown in fig. 3,854 is a good standard. The bottom board enables shovelling away accumulating gravel without injury to the wire.

Mortar Platform.—In the preparation of mortar, especially where considerable quantity is being used, a platform is usually

provided for stacking a supply of the mortar for the hods, while additional mortar is being mixed in the mortar box. This platform consists of simply a few planks laid adjacent to the box as in fig. 3,866.

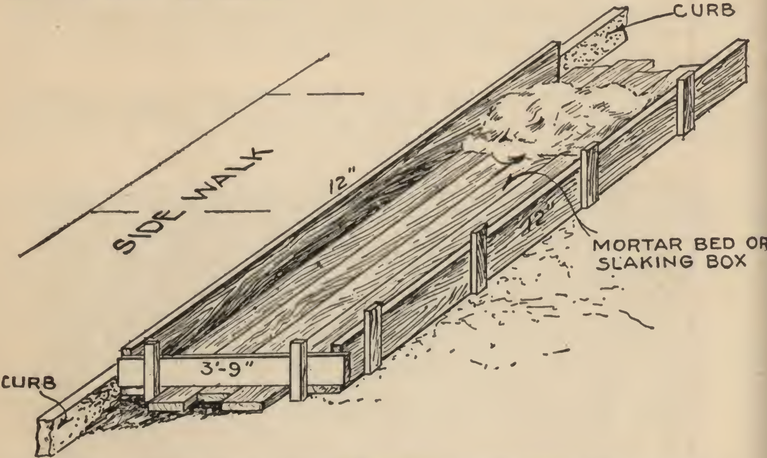


FIG. 3,865.—Mortar box erected in street against curb without special sand bed support.

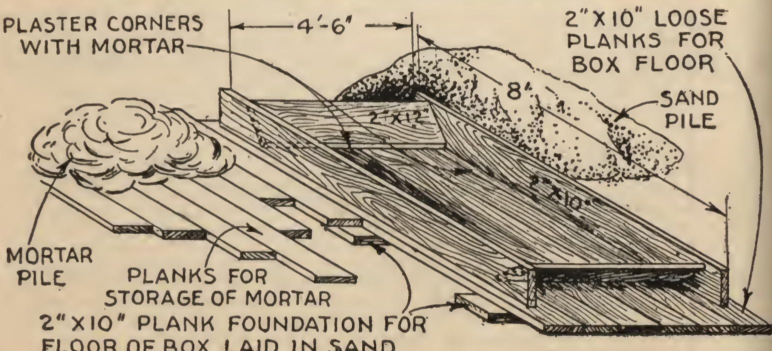


FIG. 3,866.—Mortar box and platform erected on sand bed.

Hoe, Shovel, and Hod.—A hoe is used for slaking and

mixing, and the shovel for tampering the mortar for the box to the platform and hod. These tools, as shown in figs. 3,868 and 3,869, are familiar to all and need no special description.

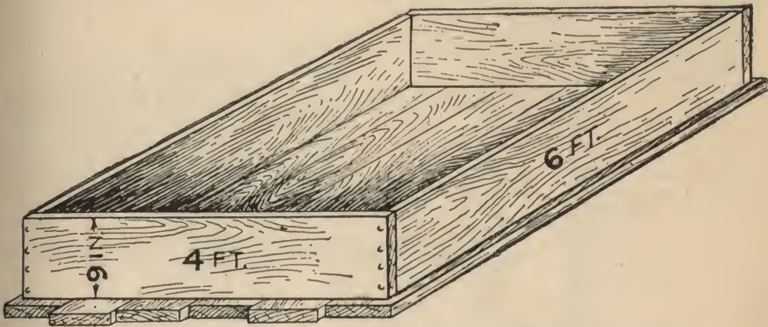
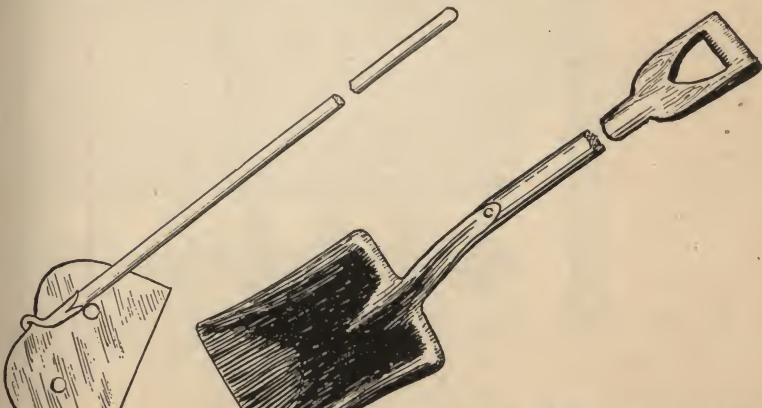


FIG. 3,867.—Small portable mortar box, especially adapted to city work in buildings.



FIGS. 3,868 and 3,869.—Ordinary hoe and shovel as used in the mixing and handling of mortar.

Fig. 3,871 shows the general appearance of a hod and figs. 3,903 to 3,910 how to make a home made hod. It is best not to use lighter than $1\frac{1}{8}''$ boards. The metal binding shown adds to the durability and lasting qualities, but is not imperative.

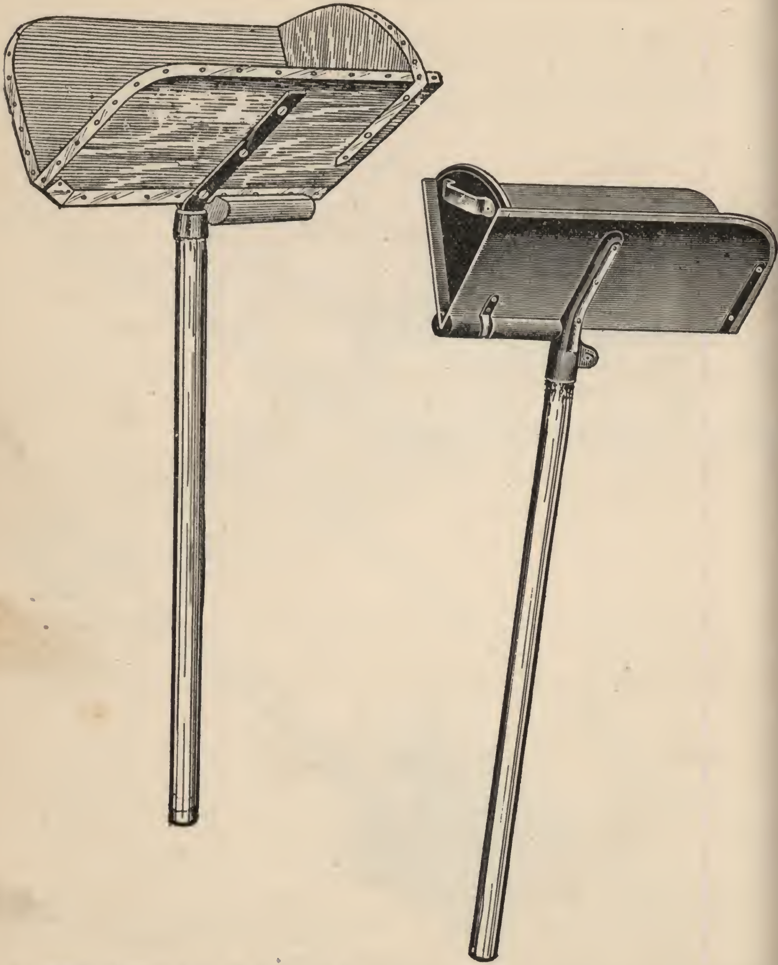


FIG. 3870.—Mortar hod. It should be made of good quality white pine. Ordinary inside measurements are: sides, $22\frac{3}{4} \times 13$; width across top, 15 ins. Hods should be balanced by attaching the handle at the proper point so they will be easy to carry. A cushion or pad is placed back of the handle to rest on the shoulder. The handle should be about 4 ft. wide. In best construction, hods are iron bound as shown.

FIG. 3,871.—Iron clad type of mortar hod.

Preparing Lime Mortar.—The various operations in preparing the mortar for use are:

1. Screening the sand.
2. Slaking the lime.
3. Proportioning.
4. Tempering.

The sand should always be screened, or much time will be lost by the bricklayers having to dig out the larger stones while they are spreading the mortar.

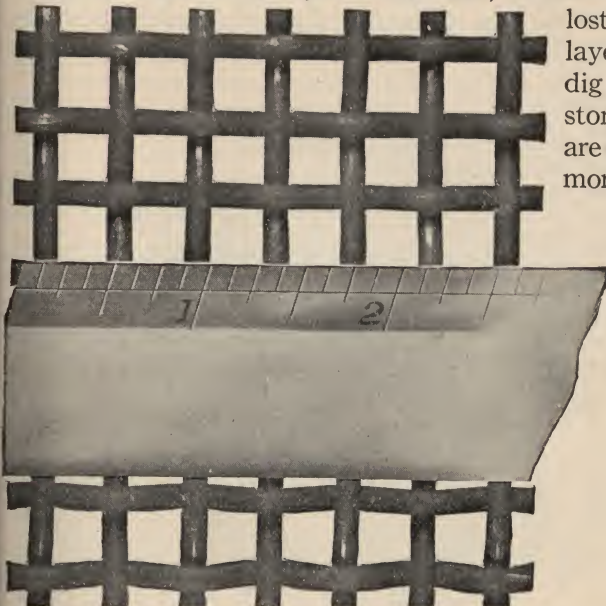


FIG. 3,872.—How to measure wire cloth. The term ***space*** means the clear opening or distance between parallel wires and is the opposite of *mesh*. By placing rule on the wire cloth as shown the space may be measured; the space being here ¼ in.

Screening the Sand.—Use a screen with long vertical and narrow horizontal spacing because it will screen the sand faster than a screen with square openings.

The operation of screening the sand is done by simply shovelling the sand against the screen as shown in fig. 3,873. The sand will pass through the screen, while pebbles, rocks, or anything larger than the mesh of the screen will fall to the bottom as shown.

Slaking the Lime.—Hydrated lime does not require any preparation. It comes on the job ready for use. Lump lime must be prepared or slaked at least one week before it is used for mortar.

Practically every lime requires slightly different manipulation in order to slake it properly. The best results can be obtained by following the directions of the manufacturer or dealer.

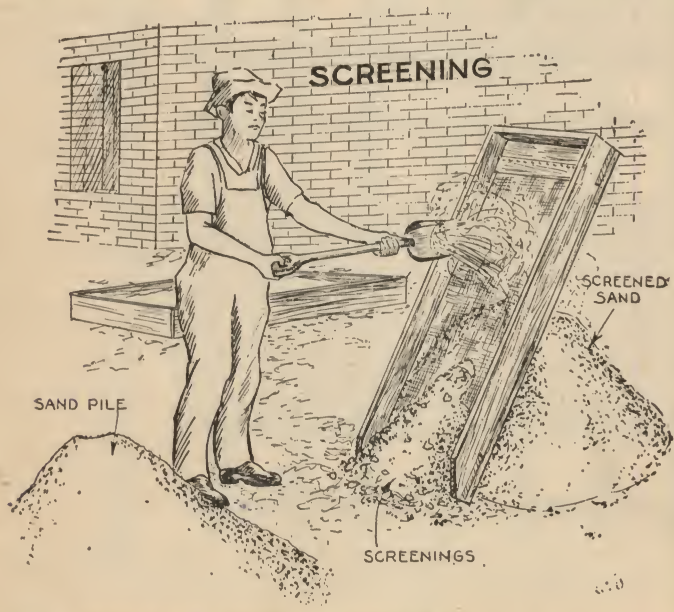


FIG. 3,873.—*Preparing lime mortar, 1. Screening the sand.*

In the absence of these the following recommendations are made.

Provide the laborer with a good supply of water. Even if there be a hose connected to the water supply it is well to have a barrel of water and a pail in case the lime begins to burn during the process of slaking.

Add water to the lime with the hose. Different limes require different volumes of water. On adding water the lime becomes very hot and gives off vapor, finally bursting to powder. During this process the lime must be kept continually wet or it will "burn" and lose its strength. Too much water also is injurious as it stops the slaking process. A little experience will soon make it possible to determine the correct amount.

In slaking the lime, form a shallow basin of screened sand in the mortar box. Place the lime in this basin and pour water over the lime until thoroughly slaked as in fig. 3,874; that is, until the action of the water expels the carbonic acid gas remaining in it after *calcining*, for lime is made

FIG. 3,874.—***Preparing lime mortar, 2. Slaking the lime.***

from calcined limestone. In the sand basin it steams and boils, when being slaked, and it will require to absorb one quarter its own weight of water before it is thoroughly slaked, and will expand to two or three times its lump size.

When the lime is properly slaked it is reduced to a slimy consistency by the laborers, using a hoe.

Proportioning the Sand.—As soon as the slaking process is complete, mix the sand with the paste and shovel it out on the wood platform, to remain until it is tempered for use.

Sometimes where a poorer grade of lime is used, there is a residue of impurities after the lime is slaked. In such cases slake the lime in a separate box, afterwards screening it into the mortar box and mixing it with the sand. Such lime does

Fig. 3,875.—*Preparing lime mortar. Proportioning the sand.*

not generally make so strong a mortar as that which leaves no residue.

There is no set rule regarding the proper proportion of sand to lime. If there be too much lime in the mortar, it sticks to the trowel; if too much sand, it is stiff and difficult to work. The amount of sand is seldom measured, but a good ratio is one part lime to 2½ parts sand *by volume*.

Fig. 3,875 shows the operation of mixing the lime and sand as usually prepared by laborers using a hoe and shovel.

Tempering Mortar.—Working the mortar and adding water to bring it to proper consistency for actual use is called *tempering*. Mortar should be tempered *until it slides easily off the trowel* as in fig. 3,876 and should be worked until all white spots of lime disappear, otherwise they will swell and pop after the mortar is laid.

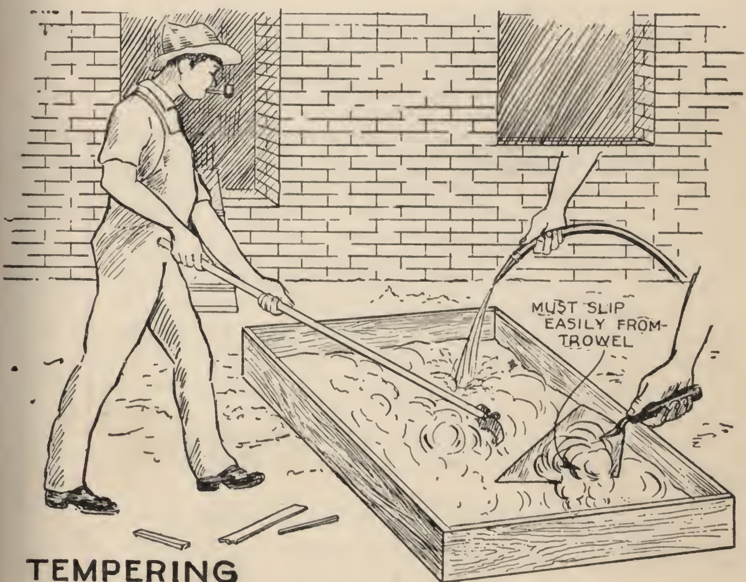


Fig. 3,876.—***Preparing lime mortar.*** *Tempering.*

Lime mortar should never be mixed too thin, and care should be exercised not to use sand too sharp, or sand which has any percentage of loam in its composition.

Handling the Mortar.—When the mortar is ready for use,

it is shoveled with a shovel into the hod and then conveyed by the hod carriers to the bricklayers' scaffold and there dumped into the mortar box.

Lime-Cement Mortar.—This kind of mortar must be used immediately after mixing because cement obtains its initial set very quickly. Lime-cement mortar has the combined qualities of both lime and cement mortar. It has both strength and good working qualities and costs less than cement mortar; it is generally used, especially in the Middle West. A specification for this character of mortar would be as follows—or in similar proportions:

"The lime mortar shall be composed of five bushels of fresh burned lime, or its hydrated equivalent, to one cubic yard of sharp river sand; the supply of fresh lime mortar to be kept well in advance of the work so that none less than two weeks old be used. The cement mortar is to be composed of one part of American Portland cement (showing a tensile strength of 500 lbs. per sq. in. on seven days' exposure) and three parts of clean sand; the cement mortar to be mixed fresh each day just before being used and in such quantities that none shall be left over at the end of the day's work. Take of the above mortars equal parts, thoroughly mix, and use fresh, not allowing the mortar to set before using in the walls."

Thus mixed, these mortars when set, become a pale gray color, of either a greenish or bluish tint, depending upon the brand of cement used. The effect of lime mortar in the mixture is to produce a much lighter color in the finished joint than is obtained by the use of a pure cement mortar.

Portland Cement Mortar.—Portland cement mortar is shorter and harder to work than lime mortar and should always be used where extra strength is required, as in exposed or heavy bearing situations, or *in cold weather when the mortar must set before it freezes.*

Because of its quick setting property cement mortar should not be made in large quantities and should never be re-tempered.

In preparing the mortar the cement and sand should first be mixed thoroughly while dry. This is best accomplished by spreading the material in

thin layers one over the other in one end of the box, and turning the mixture over three or four times with shovels or hoes. Slaked lime is then mixed with water to a thin consistency, and screened into the mortar box. It is not necessary to wet or screen hydrated lime.

There should be no mortar left over night. It will have attained its initial set and be useless the next day.

If cement mortar be used in freezing weather, means should be taken to ensure the cement obtaining its initial set quickly.

Do not put any lime in the mortar, as lime delays its setting. Salt accelerates the setting of cement mortar. A small amount not exceeding 5 per cent by weight of the water may be added to the water with which the mortar is mixed. The use of salt is not recommended, however, because it may cause efflorescence on the outside face of the wall. The materials in the wall, including the sand for the mortar, the water for mixing the mortar, and the bricks themselves, should be heated so that the mortar will obtain its initial set before it freezes. Do not wet brick which are to be laid in freezing weather.

Natural Cement Mortar.—There is a large variety of natural cements, each with characteristics of its own. They are usually sold under trade names and come complete with full directions from the manufacturer, which should be carefully followed.

NOTE.—*Quantity of mortar required* for masonry and plastering. One bbl. of Portland cement and 3 bbl. of sand, thoroughly and properly mixed, will make 3⅓ bbl., or 12 cu. ft. of good strong mortar. This will be sufficient to lay up 1½ cu. yd. of rough stone, or about 750 bricks, with from ¼ to ⅜-in. joints, or cover 125 sq. ft. of surface, 1 in. thick, or 250 sq. ft., ½ in. thick. One bbl. of natural cement and 2 bbl. of lime, mixed with about ½ bbl. of water, will make 8 cu. ft. of mortar, sufficient to lay 522 common bricks, with from ¼ to ⅜-in. joints, or about 1 cu. yd. of rough rubble. For the top coat of walks or floors, 1 bbl. of Portland cement and 1 of sand will cover from 75 to 80 sq. ft., ½ in. thick, or from 50 to 56 sq. ft., ¾ in. thick. One bbl. of Portland cement and 1½ bbl. of sand will cover from 110 to 120 sq. ft. of floor, ½ in. thick, or from 75 to 80 ft. ¾ in. thick. These figures can be considered as approximate only, as the amount of mortar will vary on different jobs.—*Kidder.*

NOTE.—*The Mixing of Mortar.*—Mortar may be mixed by hand or by mechanical mixers, the latter being preferable for the mixing of large quantities. When the mixing is by hand, it should be done on platforms made water tight to prevent the loss of cement. The cement and sand should be mixed dry in small batches and in the proportions required, the platform being clean. Water is added and the whole mass remixed until it is homogeneous and leaves the mixing hoe clean when drawn out. Mortar should never be retempered after it has begun to set.—*Kidder.*

Colored Mortar.—Colored joints may be produced in two ways:

1. By use of a natural colored sand or ground granite or other stone.

2. By use of artificial mortar colors.

If the first method be employed, white joints are obtained by using white sand or ground limestone or marble. As the color of the mortar affects greatly the appearance of the finished wall, care should be given to the selection and proper use of the colors, whether natural or artificial.

As the color of the joint after the mortar has set and dried is never the same as that of the fresh mortar, experience is the only guide for the proper preparation of the mortar.

Artificial coloring matter reduces the strength of mortar, because it adds to the fine matter in its composition.

Always buy the very best quality colors. Such a small quantity is used on a house that the difference in cost is slight on the whole job. Cheap colors may ruin the appearance of the wall.

Mixing Colored Mortar.—Artificial coloring matter should never be added to lime mortar for at least two days after the lime is slaked. Never add it to hot lime.

Provide a separate box for mixing colored mortar, located near the large box so that slaked lime may be shovelled in from the pile of stacked mortar. The more thoroughly the mortar is mixed, the less color is required. Mix the mortar to a stiff consistency when using color.

The amount of coloring matter required varies with the shade of the color, the width of the joint and brand used. Take approximately 75 lbs. of coloring matter for every 1000 bricks laid with ⅜ to ½ in. mortar joints.

The directions of the manufacturer as to the kind of color and exact amount should be noted.

CHAPTER 66

Bricklayers' Tools

The various tools used by bricklayers may be grouped and listed as:

1. Mortar tools.

    a. Trowels.
    b. Jointers.
    c. Frenchman.
    d. Tuck pointers.
    e. Hawk.
    f. Hod.

2. Alignment tools.

    a. Plumb rule.
    b. Plumb-bob and line.
    c. Spirit level
    d. Straight edges.
    e, Line and pins.
    f. Corner blocks.
    g. Square.

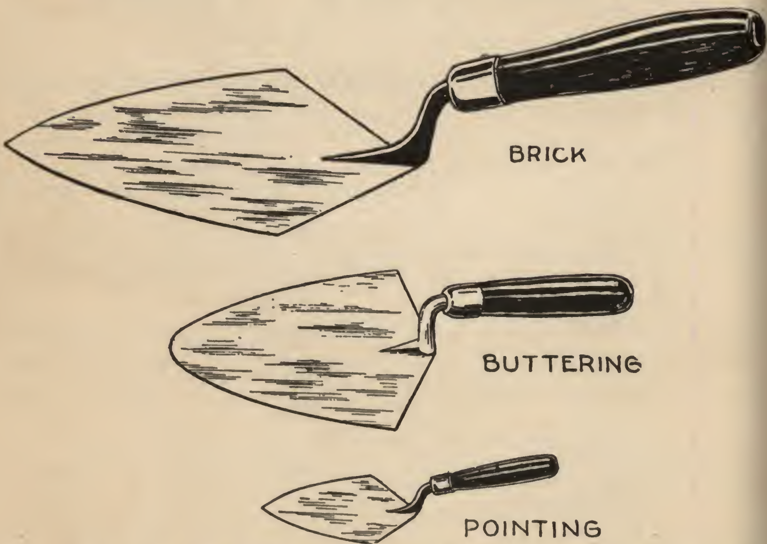
3. Measuring tools.

    a. Pocket rules.
    b. Measuring tape.

4. Cutting tools.

a. Large trowel.
b. Hammer.
c. Scutch,
d. Bolster.
e. Cold chisel.
f. Chopping block.
g. Saws.

Trowels.—By definition a trowel is *a flat triangular shaped*



FIGS. 3,877 to 3,879.—The three general types of bricklayer's trowels. Fig. 3,877, brick; fig. 3,878, buttering; fig. 3,879, pointing.

blade tooled with a rounded point and an offset handle.

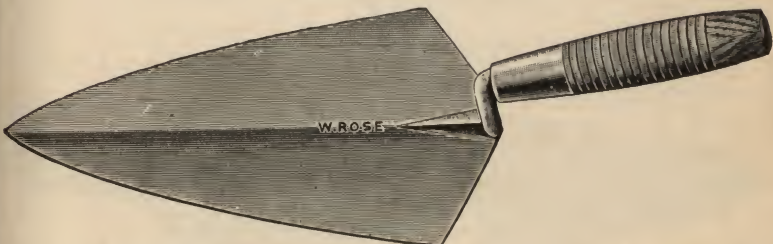
It is the most important tool of the bricklayer. There are several kinds of trowel known, as:

1. Large or brick.
2. Buttering.

3. Pointing.

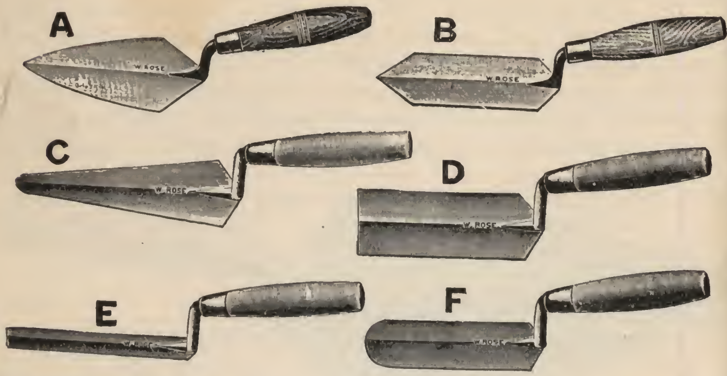
The *brick trowel* is the largest of the several types and is the one used for ordinary bricklaying as shown in figs. 3,880 and 3,881.

The sizes range from $8\frac{1}{2} \times 5$ to $14 \times 5\frac{3}{4}$. The so called *buttering trowel,* as shown in fig. 3,682, is a modified brick trowel, usually one that has been used for a long time and worn or ground down to a convenient size. This

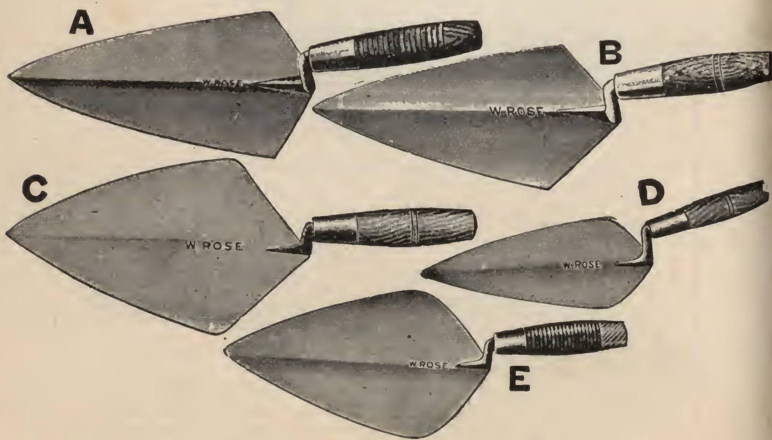


FIGS. 3,880 and 3,881.—Rose trowels. Fig. 3,880, London pattern; fig. 3,881, Philadelphia pattern. ***London pattern*** is made in sizes $8\frac{1}{2} \times 5$ to $14 \times 5\frac{3}{4}$. An old pattern, Narrow London, is $\frac{3}{4}$ ins. narrower. Long handles $5\frac{1}{2}$ and 6 ins. Blades under 10 ins. have short handles. ***Philadelphia pattern*** blades range in size from 7 to 14 ins.; $5\frac{1}{2}$ and 6 in. handles.

FIG. 3,682.—Rose buttering trowel with high shank. Blade $7\frac{1}{4} \times 4\frac{3}{8}$.



Figs. 3,883 to 3,888.—Various Rose pointing trowels. Fig. **A,** regular, with blade 3 to 7 ins. long; fig. **B,** long pointing ($1\frac{1}{2} \times 5$ to 6 in. blade) and short pointing (2×5 to 6 in. blade); fig. **C,** cross joint (3 to 6 in. blade); fig. **D,** margin, 2×5 blade; fig. **E,** joint fillers, $5 \times \frac{3}{8}$, $5 \times \frac{1}{2}$, $5 \times \frac{5}{8}$ in.; fig. **F,** round end pointing, blade 3×1, 4×1, $4\frac{1}{2} \times 1\frac{1}{4}$, $5 \times 1\frac{1}{2}$, $5\frac{1}{2} \times 1\frac{1}{2}$ and $6 \times 1\frac{1}{2}$ ins.

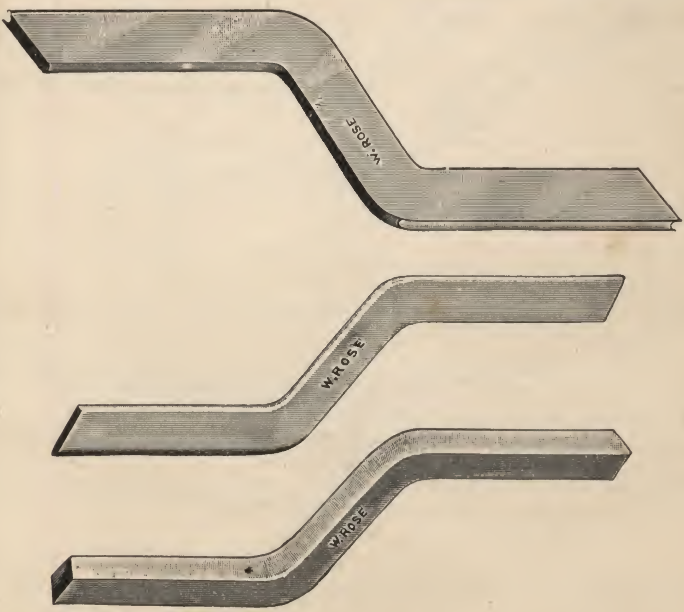


Figs. 3,889 to 3,893.—Rose trowels with various pattern heels. Fig. **A,** cut back wide heel; fig. **B,** wide heel; fig. **C,** extra wide; fig. **D,** round heel; fig. **E,** round wide heel.

trowel is used for getting fat mortar on the back of the trowel in order to "butter" face brick, so as to get a very fine joint. The term *buttering* means *spreading mortar on the brick to be laid.*

The *pointing trowel,* as its name implies, is designed for use in pointing up or facing joints. It is smaller but similar in shape to the brick trowel as shown in fig. 3,879.

There are various patterns and modifications of the three general types just shown. Two well known "patterns" are the London pattern or Brades trowel, and the Philadelphia pattern as shown in figs. 3,880 and 3,881. The London pattern weighs from $1\frac{1}{4}$ to $1\frac{1}{2}$ lbs. and is well balanced so as to be easily handled and used. Some American bricklayers prefer the Philadelphia pattern, as the weight of the blade is carried well back to the handle, and being broader is better adapted for lifting or spreading mortar



FIGS. 3,894 to 3,896.—Rose jointers or beading tools. Fig. 3,894, concave jointer; fig. 3,895, convex jointer; fig. 3,896, flat jointer. The sizes are: ***Concave jointer,*** wide end, $\frac{3}{4}$, $\frac{5}{8}$ $\frac{1}{2}$, $\frac{3}{8}$, narrow end, $\frac{1}{2}$, $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{8}$; ***convex jointer,*** wide end, $\frac{5}{8}$, $\frac{1}{2}$, $\frac{3}{8}$, narrow end, $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{8}$; ***flat jointer.*** wide end, $\frac{5}{8}$, $\frac{1}{2}$, $\frac{3}{8}$, narrow end, $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{8}$.

and cutting bricks. The round heel trowels are not very popular, but are excellent for cutting, and many good bricklayers prefer them.

Jointers.—Tools of this class are used for forming the outside edge of the mortar joints between the bricks to various ornamental shapes, as:

1. Flat.
   - *a.* Parallel.
   - *b.* Inclined.
2. Concave.
3. Convex.
4. V shape.

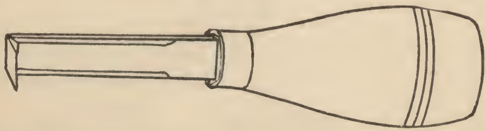


FIG. 3,897.—Knife or Frenchman, used for trimming joints, tuck pointer, etc.

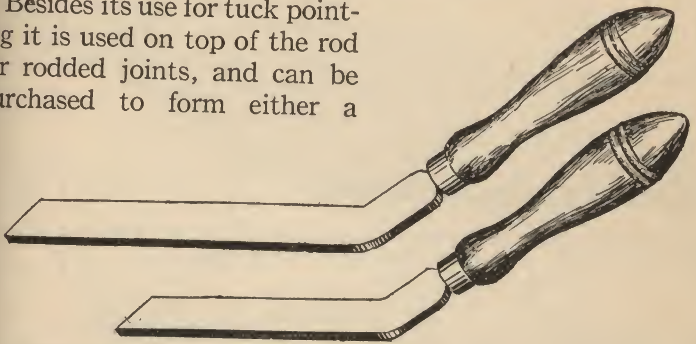
A jointer is simply a piece of flat iron having an offset bend and edge of working ends shaped to the desired form. The general appearance of these tools is shown in figs. 3,894 to 3,896. Evidently any form of joint may be struck by giving the desired shape to the ends of the jointer.

Frenchman.—This improvised tool consists usually of an old table knife with the end ground and turned up as shown in fig. 3,897. It is used for trimming joints or tuck pointing in old work. The Frenchman is also used when striking *roded*

joints; these joints are mortar joints in face brickwork allowed to project slightly outside the face of the work, and are cut to a straight finish with the Frenchman.

Tuck Pointer.—This tool is of rectangular shape bent to an angle as shown in figs. 3,898 and 3,899.

Besides its use for tuck pointing it is used on top of the rod for rodded joints, and can be purchased to form either a



FIGS. 3,898 and 3,899.—Tuck pointers.

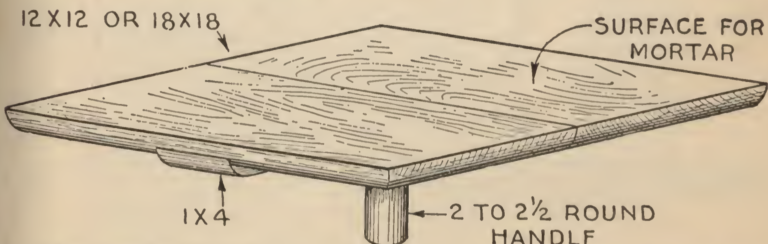


FIG. 3,900.—Home made hawk. As seen it is easily constructed. Instead of a single wide board it may be built up of two or more narrow pieces, or in fact, anything available.

square or oval bead. They are made in the following sizes: Square, ¼, 5⁄16, ⅜, ½ inch; round, 3⁄16, ¼, 5⁄16, ⅜, ½ inch.

Hawk.—This tool consists of a board 12 to 18 ins. square having a handle as shown in fig. 3,900. It is used in pointing

for holding a small quantity of mortar and is especially useful when working from a ladder or in some inconvenient or difficult place where there is no room for a mortar board.

Hawks are usually home made, though aluminum hawks may be obtained which are very desirable where considerable work has to be done.

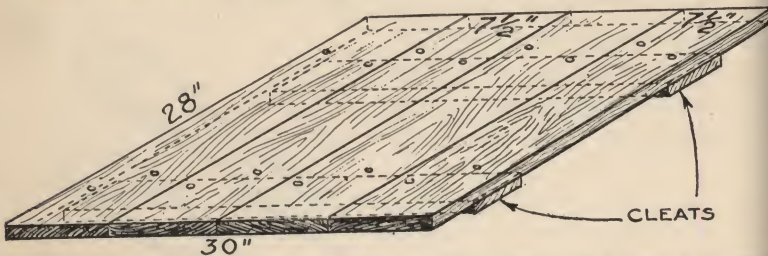


FIG. 3,901.—Mortar board. *It consists of* boards nailed on cleats and as shown is of proper size to hold a hod of mortar tempered for use in laying brick.

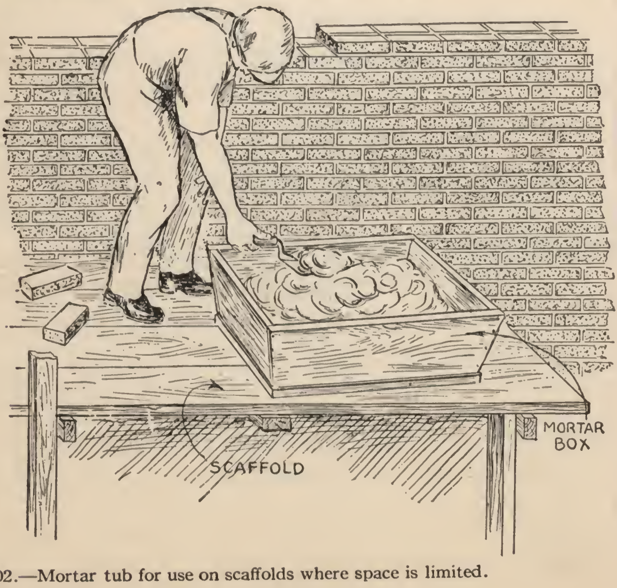
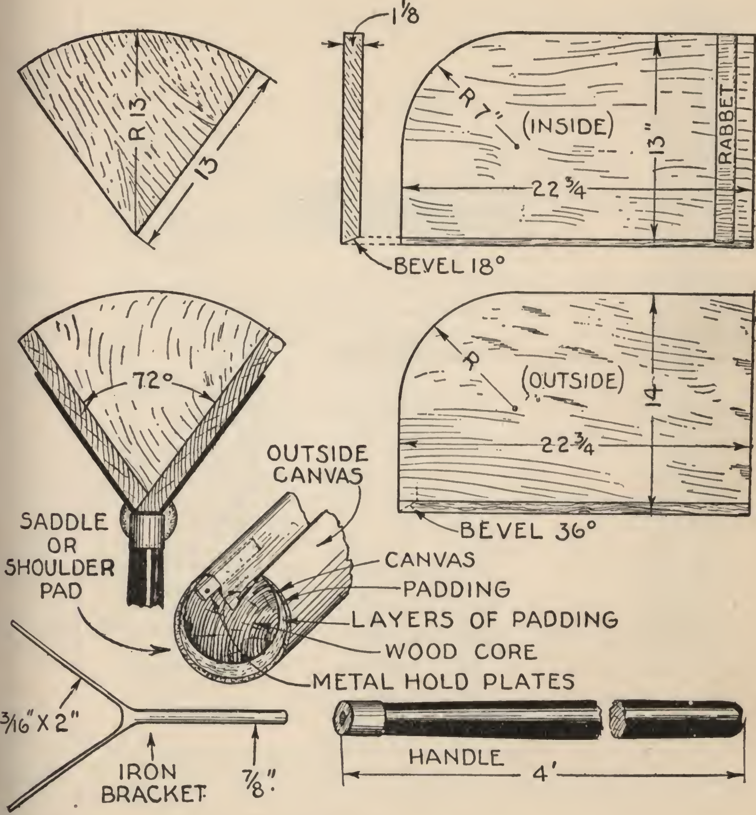
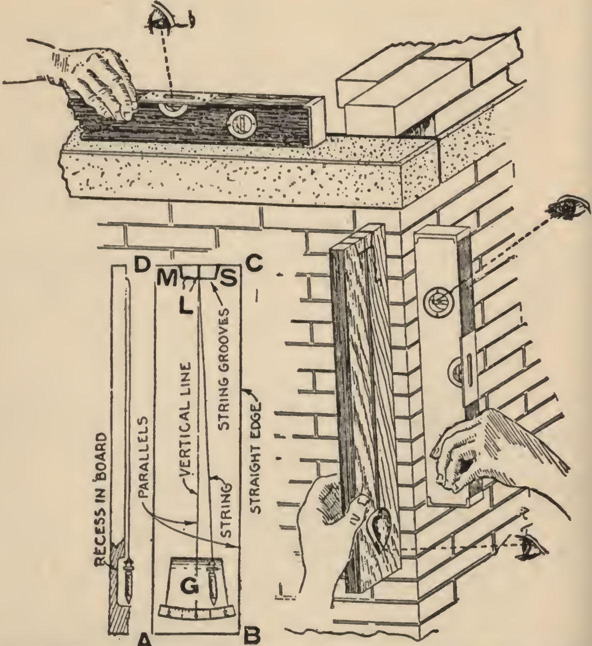


FIG. 3,902.—Mortar tub for use on scaffolds where space is limited.



FIGS. 3,903 to 3,910.—Home made hod. All hods do not have to be made exactly the same and the size may be varied. ***The illustrations*** show in detail how to make a hod to standard size of the manufactured product. The load is according to distance to be carried and conditions. White pine is the best wood for end and sides. Fir or cypress are good seconds. The sides are better rabbeted for end, or may be done without. The handle should be of tough wood, such as oak or ash, 4 feet long, 2″ diameter, bored for a ⅞″ post about 8″ deep and bound with a stout iron ferrule. The bracket is generally a blacksmith's job. With a brazing equipment it may be made in the shop. The shoulder pad is readily made around a 2″ ¾ round by tacking on layers of padding and canvas, graduating them so as to make the cushion mainly on the under side as shown in figure. It may be held in position with four metal plates as shown, or the outside canvas may be tacked to sides of hod.

FIG. 3,911.—Ordinary plumb rule.



FIGS. 3,912 and 3,913.—Plumb rule of approved construction. ***To construct,*** select preferably some hard wood and make a double straight edge ABCD, say four or five feet long and four to six ins. wide to suit the conditions of use. At the middle point L, scribe a line parallel to the straight edge sides. Cut grooves M, L and S, in which to fasten the suspension string. The lower portion of the board should be recessed as shown sufficiently for the bob to swing without interference. To make a nice job, a brass plate should be fitted across the lower side of the recess with its edge curved to an arc of radius LG. This plate should be graduated in degrees of fractions of a degree according to the range of the instrument in testing surfaces out of plumb. If the distance LG, from point of suspension to tip of bob be 60 ins. then the length of 1 degree on the scale—1.047 ins. ***Rule:*** To obtain length of 1 degree on scale multiply distance LG, from point of suspension to tip of bob by factor .01745. Each degree may be divided as closely as desired. By dividing the degrees into 12ths, each division will represent 5 minutes.

FIG. 3,914 —Brick walls of building in construction showing method of using wood level for making horizontal and vertical tests and application of plump rule for vertical test.

Plumb Rule.—With this tool the bricklayer lays his brick wall *plumb*, that is, vertical, *or perpendicular to the plane of the horizon.*

An ordinary plumb rule is shown in fig. 3,911.

It is ordinarily made of a piece of 1⅛-inch white pine, 4 or 4½ inches wide and from three feet six inches to four feet six inches long. It is planed perfectly parallel and out of wind or flat and is gauged with a scratch line in the center. Near the bottom an oval hole is cut in which the lead bob gravitates or swings on a line fastened to the top in the saw cut or slot seen in the engraving.

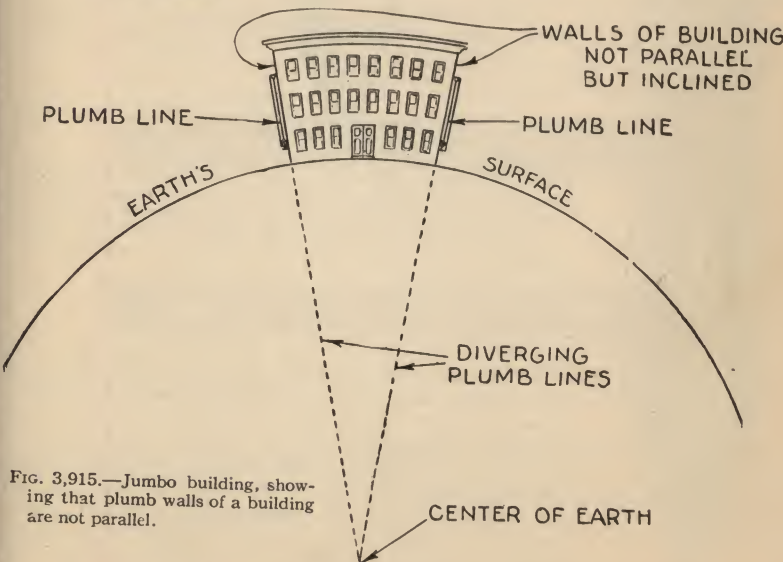
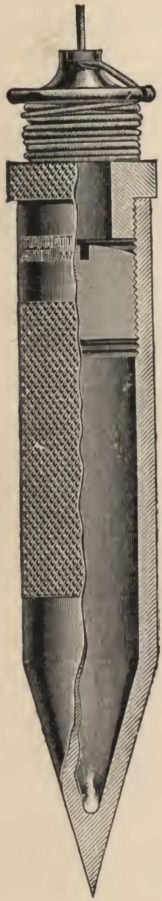


Fig. 3,915.—Jumbo building, showing that plumb walls of a building are not parallel.

To build a wall plumb, it is only necessary to place the right or left edge of the rule, allowing the bob to swing against any of the vertical edges or faces; carefully watching the bob when it swings backward and forward so that the cord line exactly strikes the gauged line on the face of the rule; when it does this the edge or face of the wall is plumb as desired. Great care should be taken to get the bob as steady as possible.

Figs. 3,912 and 3,913 show a home made plumb rule with precision scale.



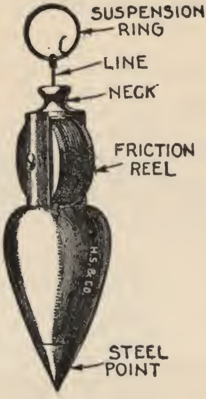


FIG. 3,916.—Adjustable plumb bob. ***A reel*** is placed between two arms at the upper end, upon which the line is wound, the end of the line being threaded through a small hole in the neck. ***In using,*** by dropping the bob with a slight jerk while the ring is held in the hand, any desired length of line may be reeled off.

The walls of a building when accurately built up plumb are ordinarily supposed to be parallel, but this is not so. The reason for this is that the surface of the earth is spherical and plumb lines which follow the direction of gravitation point toward the center of the earth, hence they are radial lines and diverge as shown in fig 3,915. Of course in reality the divergence is so slight that it cannot be noticed by eye, however, the bricklayer should know that plumb walls are not parallel.

FIG. 3,917.—Starrett mercury plumb bob. It is made from solid steel, bored and filled with mercury. The features of this design are: great weight in proportion to size, low center of gravity, small diameter, hardened and ground point, knurled body, and fastening device. By drawing the line into the peculiarly slotted neck at the top, after unwinding the required length, the bob will hang true.

Plumb Bob and Line.—The word *plumb* means *perpendicular to the plane of the horizon,* and since the plane of the horizon is perpendicular to the direction of gravity at any given point, the force due to gravity is utilized to obtain a vertical line in the device known as a *plumb bob.*

It consists of a pointed weight attached to a string. The ordinary acorn type is shown in fig. 3,916. This is an objectionable form especially for outside work; pay a little more money and get a first class tool of precision as shown in fig. 3,917.

Spirit Level.—This tool is intended primarily for determining

FIG. 3,918.—Stanley hard wood non-adjustable mason's level.

FIG. 3,919.—Stanley light wood adjustable mason's spirit level and plumb rule, with double plumb opening for bob.

the horizontal plane, but as usually constructed it determines both the horizontal and vertical planes and with the latter addition, is considerably used in place of the plumb rule in plumbing walls.

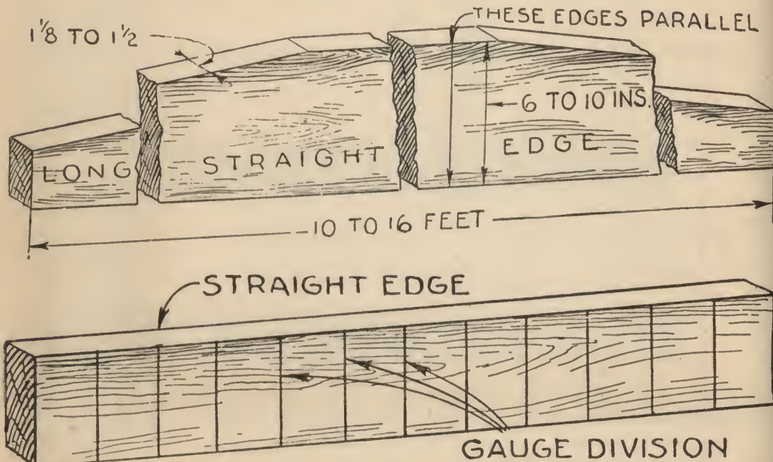
In the spirit level the adjustment to the horizon depends on the position of a bubble, or small vacant space, in the upper side of a glass tube, which is slightly curved and nearly filled with alcohol or ether.

Fig. 3,918 shows a mason's spirit level and fig. 3,919 a combination spirit level and plumb rule.

Straight Edge.—The name straight edge is given to a board where edge or edges are planed straight and true so that the tool can be used for testing surfaces.

Where both edges are planed, these are planed parallel to each other and the board is called a double straight edge as distinguished from a single straight edge. For masons' use the double straight edge is used.

There are several forms of the straight edge, as:



Figs. 3,920 and 3,921.—Straight edges. Fig. 3,920, long straight edge; fig. 3,921, short straight edge and gauge.

1. Long.
2. Short (gauge rod).
3. Pointing rule.
4. Boning rod.
5. Red joint stick.

The *long straight edge* is a long piece of selected pine wood, 1½ to 1½ inches thick, 6, 8 or 10 inches wide, and from 10 to 16 feet long, and shaped as shown in fig. 3,920. Its use is to level between points, the ordinary

spirit level being placed on the top edge and the ends of the straight edge being set on the points to be leveled.

The *short straight edge* for testing the alignment of the brick and joints is shown in fig. 3,921.

Square.—The wise carpenter will leave his so-called steel square at home when bricklayers are around, as it is quite the custom for the bricklayer to borrow the carpenter's square and the treatment it usually receives does not improve its appearance, especially in the case of a fine blued square with white scale markings.

FIGS. 3,922 and 3,923.—Southington 12 and 15 in. squares. Fig. 3,922, body 12×1, tongue, 7×1. Fig. 3,923, body, 15×1¼, tongue, 8×1.

The bricklayer who takes any interest in his work will buy a square, especially as he can well afford to. The elaborate markings of the carpenter's framing square are not necessary. Get one with simply inches and fractional inches. Figs. 3,922 and 3,923 show two desirable sizes.

Pocket Rules.—The bricklayer must from time to time

check up distances between a given number of courses to determine if the joints are being laid to uniform thickness. Also to measure for window or other openings, to size cuts for brickbats, etc. The ordinary carpenter's folding two feet rule will do, but a longer folding rule, say four or five foot, is more desirable. Figs. 3,924 and 3,925 show these two rules.

Measuring Tapes.—For laying out foundations a steel tape is a very desirable tool. These are made in a multiplicity of

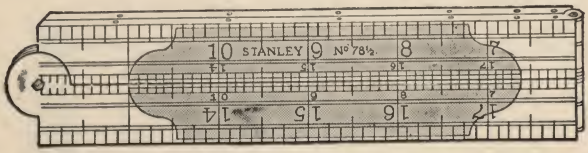


FIG. 3,924.—Stanley two foot four fold boxwood rule with double arch joints, full bound. This is a very durable form of rule for any kind of rough work.

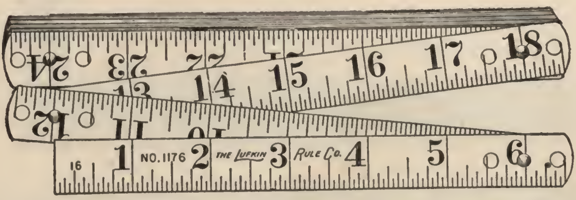


FIG. 3,925.—Lufkin folding steel rule with stop joints. *Made of* tempered steel, ¾ in. wide. Surface of rule is bright with sunken figures and lines which show up clear and distinct. Marked on both sides. Length, 2 to 8 ft., graduated in 16ths and millimetres.

styles for all kinds of work. The tape is made of linen as shown in fig. 3,926, or of steel as shown in fig. 3,927.

For ordinary work the linen tape will do, but the workman who cares for precision (as he should) will be satisfied with nothing but a steel tape.

The steel tapes here shown are made under a tension of 10 lbs. for tapes up to 100 ft. in length and 20 lbs. for those longer. A desirable system of marking is shown in fig 3,926.

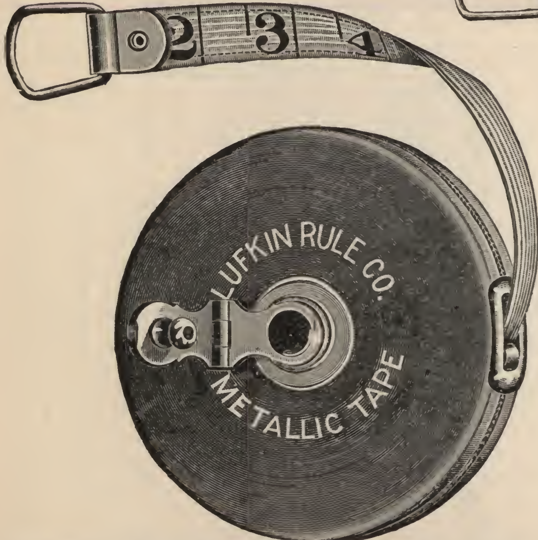


FIG. 3,926 —Lufkin *linen* measuring tape with hard leather case, folding handle and nickel- plated trimmings. Tape ⅝ in.wide with metallic warp.

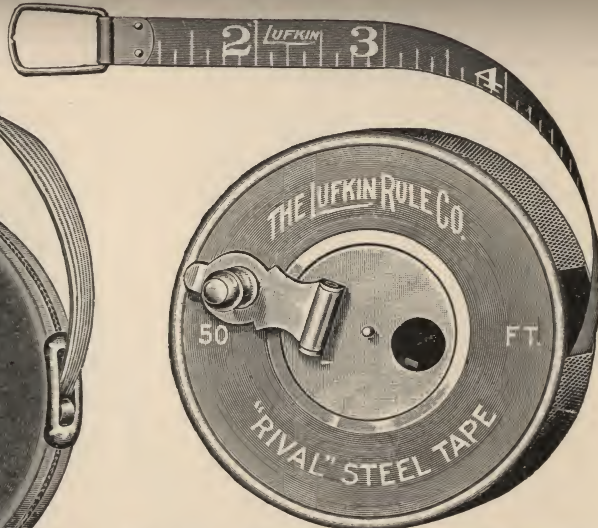


FIG. 3,927.—Lufkin *s'eel* measuring tape with nickel-plated steel case, folding flush handle opened by pressing pin on opposite side. Case has knurled edges.

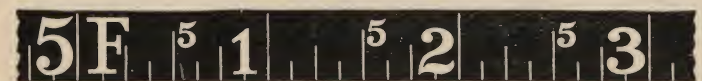
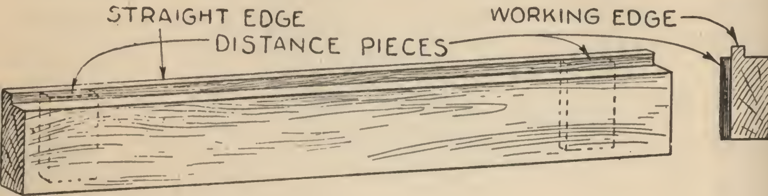


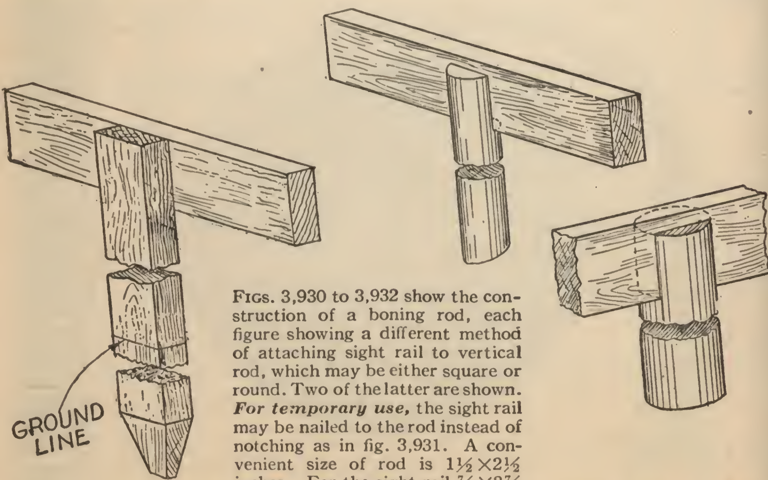
FIG. 3,928.—Lufkin system of marking tapes. ***It consists of*** repeating the foot marks at each inch in small, yet easily distinguishable figures. Thus, the total reading is brought directly before the eye, saving time in reading and eliminating chance of error.

Pointing Tool.—This is a feather-edged straight edge with two small "distance pieces" $\frac{3}{8}$ in. thick nailed at each end to keep the rule away from the wall, as in fig. 3,929. It is used for pointing, the distance pieces keeping the rule away from the wall so as to allow the mortar trimming to fall through.

By shaping the tool with the narrow working edge projection, as seen in the end view, the pointing tool is easier guided. The distance pieces should



FIGS. 3,929.—Pointing tool.



FIGS. 3,930 to 3,932 show the construction of a boning rod, each figure showing a different method of attaching sight rail to vertical rod, which may be either square or round. Two of the latter are shown. ***For temporary use,*** the sight rail may be nailed to the rod instead of notching as in fig. 3,931. A convenient size of rod is $1\frac{1}{2} \times 2\frac{1}{2}$ inches. For the sight rail $\frac{7}{8} \times 2\frac{7}{8}$ inches is ample. Fig. 3,930 has a longer and pointed rod, so that it may be stuck in the earth outside of wall for foundation work. In fig. 3,932 the sight rail is filled in a groove cut on the end of the rod.

stop about ½ in. below the working edge so that the pointing tool may be worked the entire length of the straight edge without striking the distance pieces. This tool, as well as numerous other bricklayers' tools, is easily home made.

Boning Rods.—These are alignment sights used in laying brick sidewalks, etc. The rod *consists* of a stick with a cross piece placed at the top end, as in figs. 3,930 to 3,932. In using, two end rods are planted at the desired level and an intermediate rod used in levelling the brick by sighting across the three rods as shown in fig. 3,934.

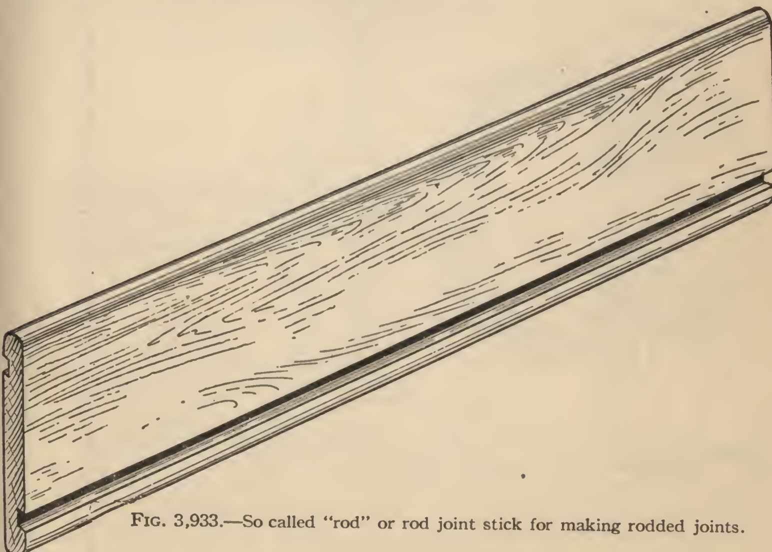


FIG. 3,933.—So called "rod" or rod joint stick for making rodded joints.

Rod Joint Stick.—The misuse of the term "rod" for the tool, and form of joint known as "rodded joint" is ridiculous and should not be employed by the better informed workman.

A board is not a rod and no stretch of the imagination can make it so. The author accordingly recommends the term *stick* in place of rod.

This tool is generally applied in striking the so-called "rodded joints" which are mortar joints in face brickwork allowed to project slightly outside the face of the work, being cut to a straight finish with a Frenchman. Fig. 3,933 shows the general appearance of a rod joint stick.

Line and Pins.—The bricklayer requires as a guide in laying brick, a line and pins. An approved form of pin is shown in

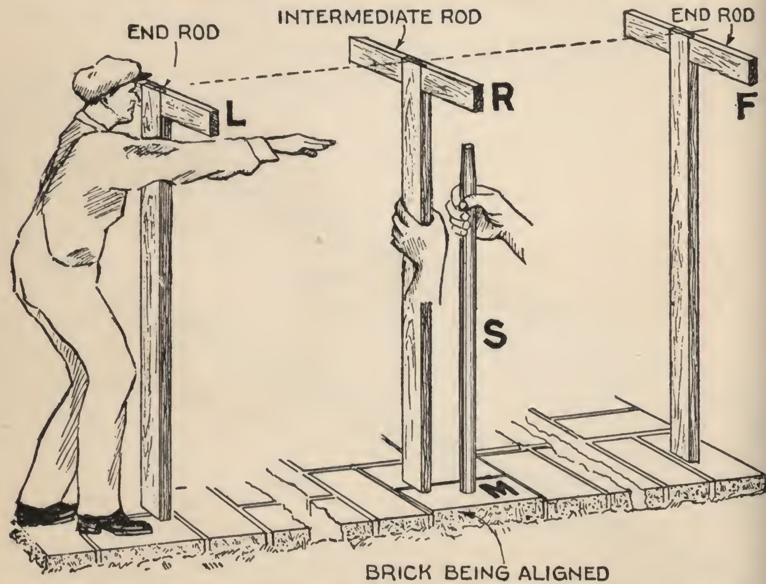


FIG. 3,934.—Method of using boning rods in laying sidewalk. The intermediate rod is placed on the brick M, being laid and a sight taken across the three rods L, R, F. Brick M, is tapped with a wooden mallet or tamp S, until the sight rail of rod R, comes in line with L and F. A hammer should not be used in aligning the brick because it is liable to crack them.

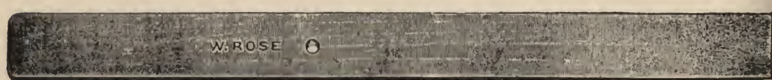


FIG. 3,935.—Rose line pin. For a long line a stiff pin, $7\frac{5}{8} \times \frac{1}{8}$ is recommended.

fig. 3,935; however a slouchy workman will be satisfied with a couple of second-hand nails or any makeshift method of holding the line. In order to get a true wall the line should swing from the top edge of the brick wall, and should not be attached to a pin in a joint, three or four brick lengths away from the corner.

A good wall depends upon laying brick horizontal. This cannot be done unless the bricklayer put up the line on the corner very frequently, or unless his brick on the corner have been laid with precision and each course properly leveled, tested and squared.

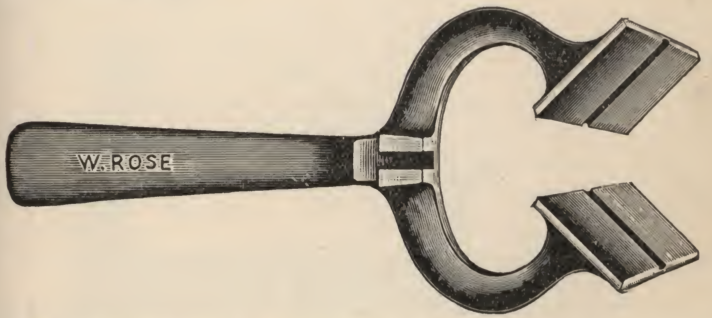


Fig. 3,936.—Rose corner block to hold the line.

The pins being firmly planted the desired condition is to stretch the line until it becomes straight. This is physically impossible because there will always be more or less sag. Hence get a line that is very strong and very light. Some of the better quality fish lines will answer these requirements.

Corner Blocks. In lieu of pins, corner blocks are sometimes used. Fig. 3,936 shows a corner block, and fig. 3,937, how it is used. The two faces of the tool register with the end and top face of the end brick, the line passing through the groove; the block is retained in position by the taut string pressing the faces of the block against the brick.

Large Trowel.—For rough cutting, or hit or miss, where accuracy is not essential, the large trowel is used. This tool has been fully described and no further description is necessary.

In using, the mason holding the brick in one hand gives it a sharp blow with the edge of the trowel, cracking the brick into two bats.

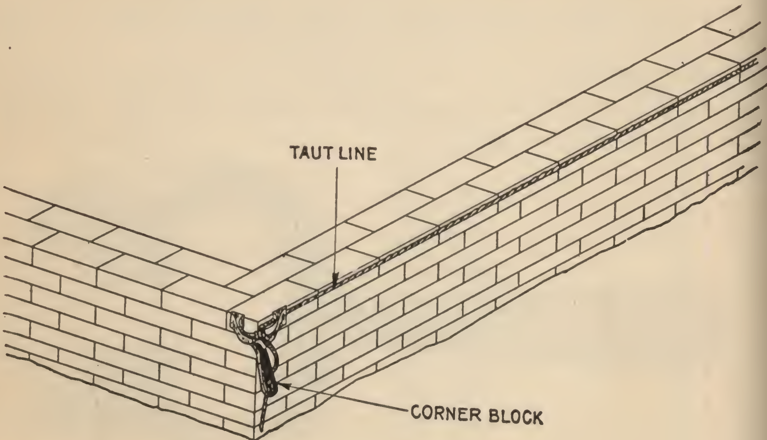


Fig. 3,937.—Method of using corner block.

Fig. 3,938.—Masons' linen line. Light, 84 ft. length; heavy, 50 ft. length. An inferior cotton line can be obtained, 450 to 600 ft. per lb. hank.

Brick Hammer.—This tool is peculiar in its shape, having a head of a few inches on one end and a pick shaped extension in the form of a cutter on the other as shown in fig. 3,939.

To split or break bricks in large pieces, the square head of the hammer is used, the cutting end of the hammer being used to cut down the rough face of a split brick, or to cut skewbacks, etc. Most bricklayers use the cutting end of the hammer too much and the head not enough. A brick hammer is also used in plumbing a corner, for tapping bricks lightly in their bed.

Scutch.—A scutch consists of a double ended flat cutting head attached at its middle point to a handle as shown in

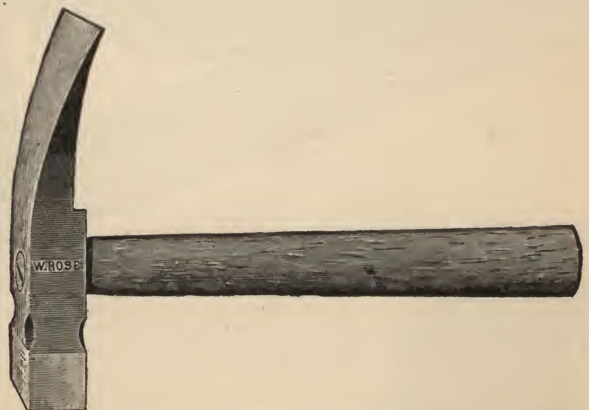


FIG. 3,939.—Rose brick hammer. Sizes 2, 2½ and 3 lbs.; second growth hickory handle.

fig. 3,940. It is used to hack away the rough portions on the side of a brick after the edges have been cut by the tin saw and bolster.

In cutting brick the scutch should be used **more** *and the trowel* ***less.***

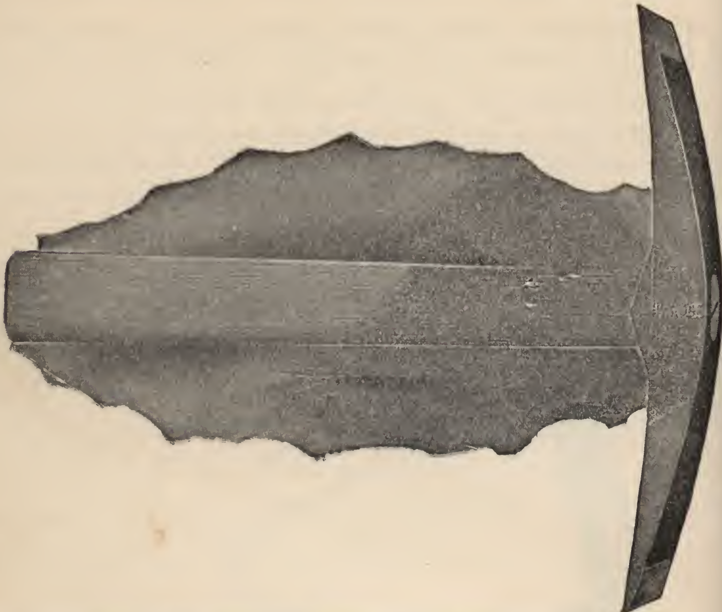


FIG. 3,940.—Rose scutch. Weight 2 lbs. Second growth hickory handle.

FIG. 3,941.—Rose bolster or brick chisel. Cutting edge 2, 3 and 4 ins. in length, beveled on one side.

Bolster.—By definition a bolster is *a short broad form of cold chisel*, used to cut pieces from brick in dressing them to shape.

The general appearance of this tool is shown in fig. 3,941.

In using, the cutting edge of the bolster is placed on the line of desired cut and given a sharp blow with a hammer. It is a tool of precision in cutting.

Cold Chisel.—This is the familiar tool of general use in mechanics. The bricklayer finds frequent use for it in trimming

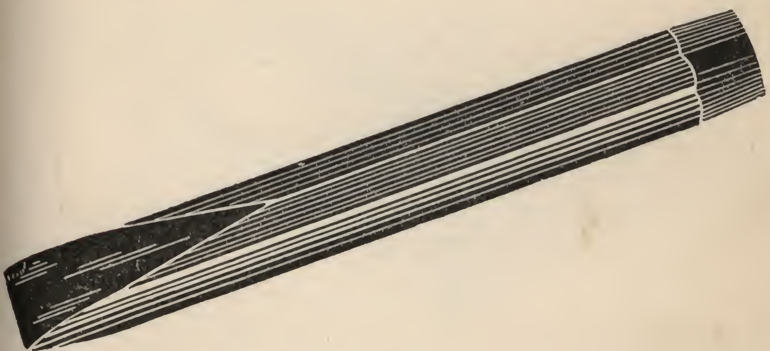


FIG. 3,942.—Ordinary cold chisel. ***This tool*** should be made of hard, strong steel, tapering to one end which terminates in a beveled point, which is tempered so that the chisel can cut metal when struck a blow with a hammer or mallet on the other end, but is not so hard that it breaks under the blows. A chisel should be tempered from a brownish yellow to a light purple (500° to 530° F.). The sides of a *chipping chisel* should slope at 22° to 25°, the cutting bevels at 80°; a *bolt cropping chisel* should have an angle of 30° between the sides and 75° at the point. Oval steel is recommended for the former and hexagon for the latter, to secure an easier grip and also serve to distinguish one tool from the other.

cutting holes and for operations requiring a smaller tool than the bolster. Fig. 3,942 shows the ordinary cold chisel.

Chopping Block.—This is, as shown in fig. 3,943, an arrangement of two blocks of wood so fixed as to support a brick in an angular position convenient for cutting.

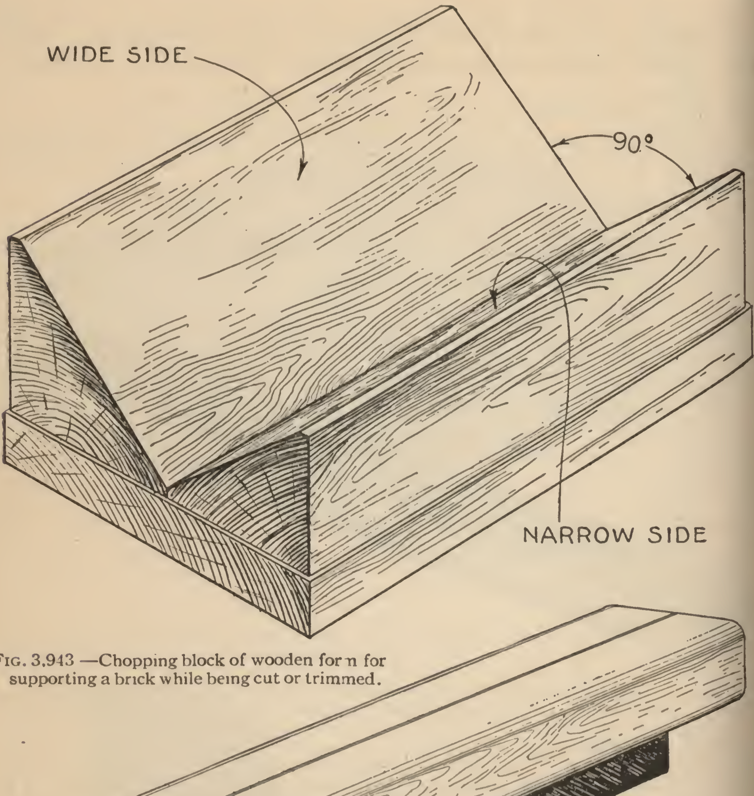
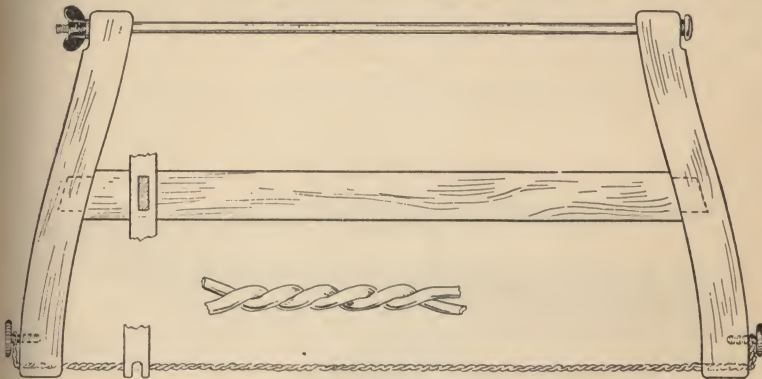


Fig. 3,943 —Chopping block of wooden form for supporting a brick while being cut or trimmed.

Fig. 3,944.—Tin saw for scoring brick preliminary to using bolster.

Saws.—Two kinds of saws are used: 1, the line saw as shown in figs. 3,944 and 3,945 for making a groove ⅛ in. deep preliminary to cutting hard brick with a bolster, and 2, the frame saw as shown in figs. 3,945 and 3,946 for cutting soft rubbing brick. The



FIGS. 3,945 and 3,946.—Frame saw and enlarged detail of twisted wire blade.

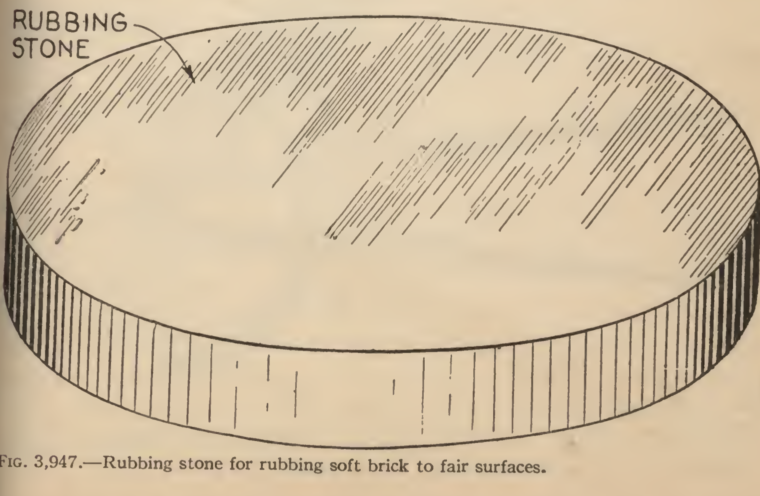


FIG. 3,947.—Rubbing stone for rubbing soft brick to fair surfaces.

saw consists of a frame holding the blade which is of twisted soft steel or malleable iron wire (No. 16 *B.w.g.*).

Rubbing Stone.—This tool consists of a circular slab of gritty stone, as shown in fig. 3,947, and is used for rubbing the faces of soft brick to a true surface.

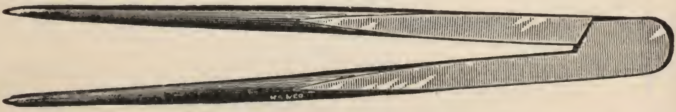


FIG. 3,948.—Compasses. ***This makeshift tool,*** when used, should be used for describing arcs or circles *only* and not for *dividing*, especially where a given arc or line is to be divided into many parts, because an extremely small error in the setting will make a big error in the position of the last division.

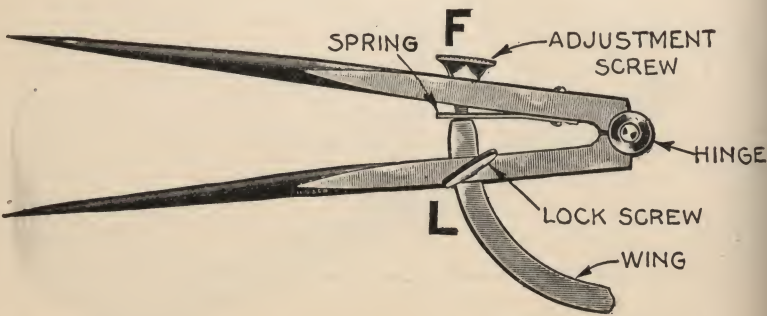


FIG. 3,949.—Winged dividers. ***A precision tool*** for describing and dividing arcs and circles. Evidently when the dividers are locked to the approximate setting by lock screw **L**, the tool can be set with precision to the exact dimension by turning the adjustment screw **F**, against which the leg is always firmly held by the spring which prevents any lost motion.

Compasses and Winged Dividers.—In laying out small circular work these tools are used, the choice depending on the degree of precision required. For ordinary laying out, the makeshift tool shown in fig. 3,948 is used, but for precision the one shown in fig. 3,949.

Although brickwork is pretty rough work, the use of precision tools is as a general principle, always commendable, especially where such use requires no greater effort but in some cases results in a saving of time and temper.

Sliding T Bevel.—A "bevel" is virtually a try square having

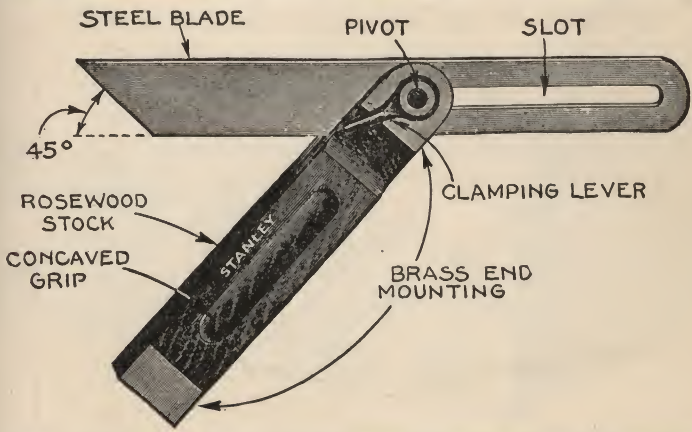


FIG. 3,950.—Sliding T bevel with steel blade, rosewood handle and brass end mountings. *It is incorrectly called the **bevel square**.* As the size of a bevel may be expressed by the length of either its stick or blade, care should be taken to specify which dimension is given in ordering to avoid mistakes.

a sliding adjustable blade that can be set at any angle with the stick. In construction the stick may be of wood or steel; when of wood it has brass mountings at each end and is sometimes concaved along its length. The blade is of steel with parallel sides and its end at 45° with the sides as shown in fig. 3,950.

It is often useful to the bricklayer in fair cutting brick to special angular shapes where the job must be done with precision.

Tool Bag.—A bag of proper size should be provided to hold

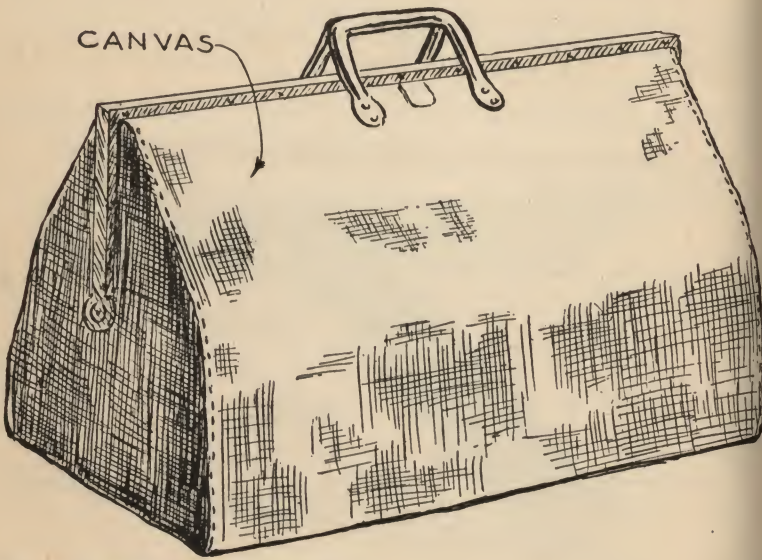


FIG. 3,951.—**Bricklayers' canvas tool bag.**

the various small tools used by the bricklayer. The bag is usually made of canvas and can be readily obtained at supply houses at a reasonable price. It is shaped like a valise as shown in fig. 3,951.

CHAPTER 67

Handling the Materials

In order that bricklaying may be done efficiently and without interruptions, some brick and mortar should be carried and properly placed so that the bricklayer will always have a supply within easy reach. This involves not only the proper system of working by the brick tenders but the erection of suitable scaffolding as the work progresses.

Preliminary Treatment of Brick.—It is important that the brick be wet before being laid except in freezing weather. The hotter and dryer the weather, the more water should be used. If the brick be not wet, they will, as previously fully explained, absorb the moisture from the mortar, which will interfere with setting and adhesion to the brick.

Bricklayers prefer to work with dry brick, because they are lighter. The brick should not be made so wet that it will slide on a bed of mortar. Wetting the brick may be done either with a hose or pail as in fig. 3,952.

Carrying Brick and Mortar.—These materials are generally handled in wheel barrows for walls up to the height of the second story joists; above this point they are most conveniently carried in hods. An inexperienced man, however, will have

some difficulty in carrying a full hod up a ladder, hence cleated runs of 2 in. scaffold plank should be provided wherever possible in preference to ladders as shown in fig. 3,953.

Location of Brick Pile.—Where the face of the wall is to be laid of selected common brick sorted out at the job, always locate the brick pile so that the man who is sorting can work

FIG. 3,952.—Two methods of wetting the brick: 1, with hose from hydrant, as at **M**; 2, with pail of water, as at **S**.

in the shade. He will do faster and better work in the shade than in the sun.

Face Brick.—When face brick are delivered on the job, they should be immediately compared with the sample,

previously selected, for color, size and quality, to prevent any misunderstanding later when they are laid in the wall.

If shipped by freight, they should be examined before being unloaded from the car. Face brick should be stacked in neat piles, laid either on edge, face up and protected with straw, or on their sides in such a way as

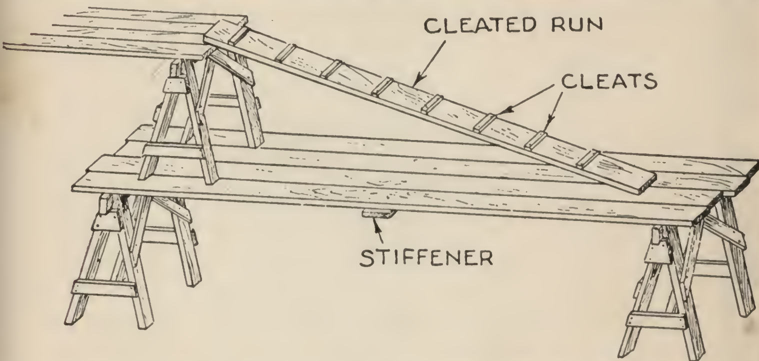


FIG. 3,953.—Cleated run, which should be used wherever possible in place of ladders.

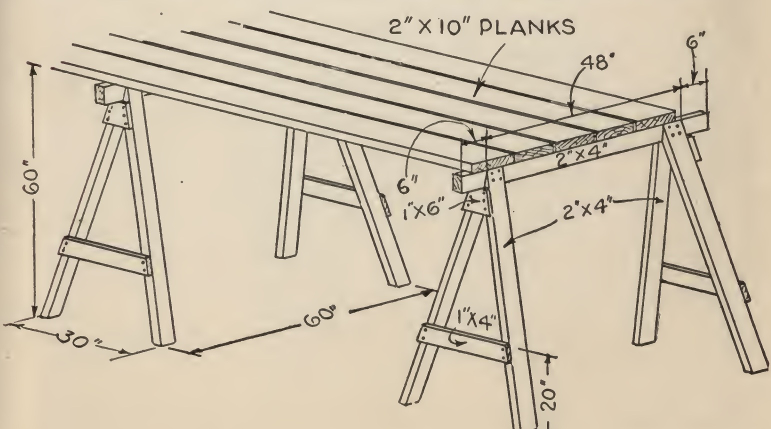


FIG. 3,954.—Detail of bricklayers' scaffold, showing ordinary sizes of the various members. Horses and planks ordinarily of yellow pine.

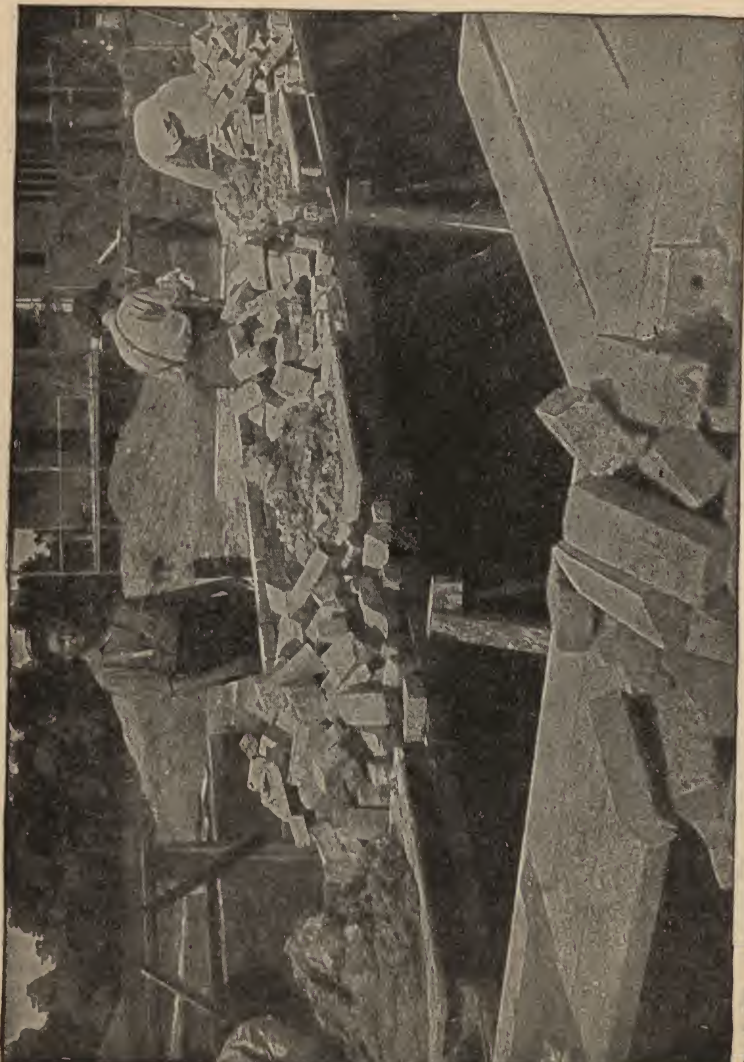


FIG. 3,955.—A typical scaffold on a typical house job, showing placement of the mortar and brick in alternate piles. Note the mortar boards.

to protect the faces. Laborers, in carrying face brick to the mason, should place them face up for the convenience of handling. Except on large jobs common brick are not usually stacked. They are dumped in a pile which makes it easier to wet them.

Lime and Cement.—Lump lime should always be stored in a covered box to keep it dry. This box should have a hinged

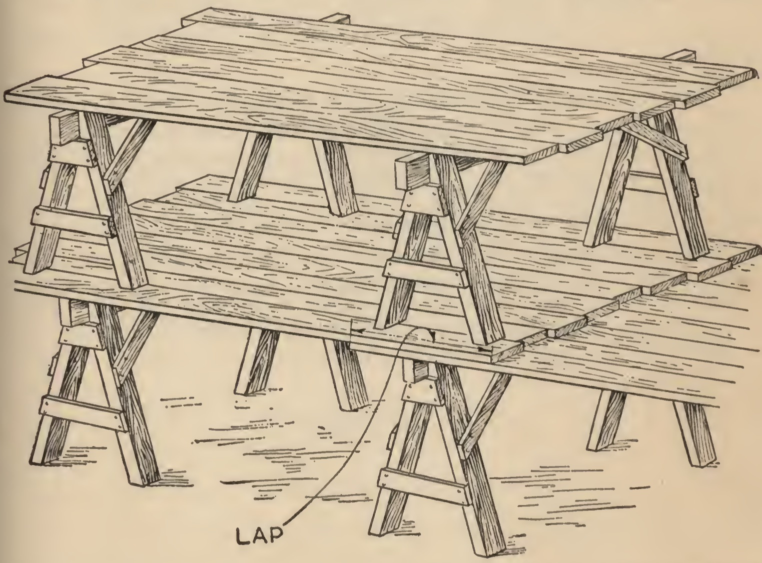


FIG. 3,956.—Method of building up ordinary bricklayers' scaffold composed of horses and planks. Note method of lapping the planks at points of support.

opening on one side, at the bottom, from which the lime may be conveniently removed.

Lump lime should be slaked at least a week before used to allow for thorough hydration and cooling. Hydrated lime and cement should be carefully protected from the weather by stacking the sacks on planks laid on the ground and by a covering of planks and tarpaulin.

The sand pile should be located as near the mortar box as possible for

convenience in handling. In case the sand need screening, the sand pile should be located at such a distance from the mortar box that when the sand is thrown through the sieve, it will form a pile adjacent to the mortar box.

Scaffolding.—The only scaffolding required for a house or small brick building are trestles or horses 5 feet high, 2 inch plank to lay on them, and some 2 inch plank for wheel barrow runs and 2 inch plank for cleated runs for the brick and mortar tenders.

Plank for scaffolding and runs should not be less than 2×10. Sometimes the floor joists intended for the floor above are laid on the trestles and used for scaffold planks. When the wall is built to the height of the bottom of the joists, the scaffold planks are swung up to form the joists. If hemlock joists be used, this practice should not be followed. Some states have laws prohibiting the use of hemlock for scaffolding.

The horses may be built as shown in fig. 3,954, or made to hinge at the top with an iron brace across the bottom, for convenience in loading on wagon. Always keep the trestles 3 inches away from the inside face of the wall, so that when a hod of brick is thrown down, the swing of the scaffold will not push out the green wall.

CHAPTER 68

How to Lay Brick

The operation of piling up brick one on top of another and separated by a layer of mortar, as performed by the bricklayer, is not done in a haphazard way but according to a well ordered method of procedure. It requires, like most other undertakings, a knowledge of the principles involved and some experience to become a good bricklayer. Preliminary to taking up bricklaying, the student should be familiar with the terms used by bricklayers as here given.

Definitions

Absorbent. Capable of taking in water or moisture.

Abutment. That part at the end of any pier or wall which supports the arch to prevent the arches from spreading,—to resist the lateral thrust.

Accurately. With a high degree of exactness; according to true measurements.

Air Space. A cavity or space in the wall, or between building materials.

All-Stretcher Bond. Bond showing only stretchers on the face of the wall, each stretcher divided evenly over the stretchers under it.

Alumina. A mineral contained in the clay used for brickmaking.

American Bond.—That bond in which a header course occurs every seventh course.

Angle-Bar. In joinery, an upright bar at the angles of polygonal windows; a mullion.

Angle Iron. A structural piece of steel in the form of a 90° angle used in certain situations to sustain brickwork.

Anta, Antæ. A name given to a pilaster when attached to a wall. Vitruvius calls pilasters parastatæ when insulated. They are not usually diminished and in all Greek examples their capitals are different from those of the columns they accompany.

Apprenticeship. The period, and also the system, of learning to become a skilled mechanic by working in the trade under direction.

Apron. A plain or moulded piece of finish below the stool of a window, put on to cover the rough edge of the plastering.

Arcade. A range of arches, supported either on columns or on piers, and detached or attached to the wall.

Arch. The brick work built to support its own weight and the weight of the wall above, which is constructed over windows, doors, and other openings.

Arch-Buttress. Sometimes called a flying buttress; an arch springing from a buttress, or pier.

Artificial. That which is done by artifice, as opposed to what is natural or produced by nature.

Arris. The meeting of two surfaces producing an angle.

Ashlar Line. The main line of the surface of a wall of the super-structure.

Axis. The spindle or center of any rotative motion. In a sphere, an imaginary line through the center.

Babylon. The capital city of the ancient empire of Babylonia.

Babylonia. An ancient empire of the Euphrates valley which 2250 years before Christ was the center of the world's commerce and of the arts and sciences.

Backboard. A temporary board on the outside of a scaffold.

Backing. The part of the wall behind the face brick.

Backing Up. Laying the inside portion of the wall after the facing of the wall has been built header high.

Backing of a Wall.—The rough inner face of a wall; earth deposited behind a retaining wall, etc.

Balanced. Made symmetrical, and in correct proportion.

Basement. The lower part of a house or building, usually below the ground.

Bat. Any part of a brick intentionally or accidentally broken off.

Batter. The slope backwards of the face of the wall, opposite to "overhang."

Batter Stick. A tapering stick used in connection with a plumb rule for building battering surfaces.

Bay. Any division or compartment of an arcade, roof, etc. Thus each space, from pillar to pillar, in a cathedral is called a bay, or severy.

Bay Window. Any window projecting outward from the wall of a building, either square or polygonal on plan, and commencing from the ground. If they be carried on projecting corbels, they are called Oriel windows. Their use seems to have been confined to the later periods. In the Tudor and Elizabethan styles they are often semicircular in plan, in which case some think it more correct to call then bow Windows.

Beam. A piece of timber, iron, or steel, or other material used to support heavy flooring, or the weight over an opening which is supported by walls, columns, or posts at either end.

Bearing Wall or Partition. A wall which supports the floors and roofs in a building.

Bed. The horizontal surface on which the bricks of the wall lie in courses. Also, the mortar on which the brick rest.

Bedford Limestone. A certain formation of limestone rock which is called Bedford because it was first found at the City of Bedford, Ohio.

Bed Joint. A joint between two horizontal courses of brick.

Belt Course. A horizontal course of brick or other material usually projecting and generally in line with window sills or heads.

Benches. Brick in that part of the kiln next to the fire, that are generally baked to vitrification.

Bench Mark. A well defined mark, accurately established, in a protected location on some immovable object, as a point of reference.

Blocking. A method of building two adjoining or intersecting walls not built at the same time, by which the walls are tied together by offset and overhanding blocks of several courses of brick.

Body Brick. The best brick in the kiln. The brick that are baked hardest with the least distortion.

Bond. The overlapping of brick in various ways so as to give both longitudinal and transverse strength to the wall, and at the same time produce a pleasing appearance.

Breaking Joint. The placing of brick so that no two vertical or head joints come immediately over one another.

Breast of a Window. The masonry forming the back of the recess and the parapet under the window sill.

Brick. A standard unit of building material, made by fashioning clay into rectangular solid blocks, and subjecting them to burning in a kiln.

Brick and Brick. A method of laying brick by which the brick are laid touching each other with only mortar enough to fill the irregularities of the surfaces.

Brick Veneer. The outside facing of brickwork used to cover a wall built of other material; usually refers to brick walls inclosing a frame building.

Brickwork. Masses of wall built out of bricks laid in mortar.

Builder's Tape. A long, narrow, flat steel band with feet and inches marked upon it, which will easily wind up on a reel so as to go into one's pocket.

Bulging. Swelling.

Bull Header. A brick laid on its edge showing only the end on the face of the wall.

Bull Stretcher. A brick laid on edge so as to show on the face the broad side of the brick.

Buttered Joint. A very thin mortar joint made by scraping a small quantity of mortar with the trowel on all edges of the brick and laying it without the usual mortar bed.

Buttering. Spreading mortar on the brick before it is laid.

Buttress. Masonry projecting from a wall, and intended to strengthen the same against the thrust of a roof or vault. Buttresses are no doubt derived from the classic plasters which serve to strengthen walls where there is a pressure of a girder or roof-timber. In very early work, they have little projection, and, in fact, are "strip pilasters." In Norman work they are wider, with very little projection, and generally stop under a cornice or corbel table

Early English buttresses project considerably, sometimes with deep sloping weatherings in several stages and sometimes with gabled heads. Sometimes they are chamfered, and sometimes the angles have jamb shafts.

At Wells and Salisbury, England, they are richly ornamented with canopies and statues. In the Decorated period they became richly paneled in stages, and often finish with niches and statues and elegantly carved and crocketed gablets, as at York, England. In the Perpendicular period the weatherings became waved, and they frequently terminate with niches and pinnacles.

Buttress, Flying. A detached buttress or pier of masonry at some distance from a wall, and connected therewith by an arch or a portion of an arch, so as to discharge the thrust of a roof or vault on some strong point.

Camber. A convexity upon an upper surface.

Cavity Wall. A wall which has an air space built in, usually back of the outside four inches.

Cell. One of the hollow spaces in building tile.

Cement. A burned mixture of clay and limestone pulverized for making mortar or concrete.

Center. The temporary support to hold up the arch while it is being built. Also means to find the center point for the curve of a segment in an arch.

Centering. The temporary frame or template on which an arch is turned.

Center Pieces. The temporary support used to hold up the arch while it is being constructed, and until it is set.

Chase. A vertical recess on the inside face of a wall formed by omitting one or more bricks in each course to accommodate plumbing, heating, or other pipes.

Chimney. A shaft built to carry off smoke.

Chimney Breast. The projection on the interior or exterior face of a wall caused by fireplace or flues.

Chimney Lining. That fire clay, or terra cotta material, made to be built inside of a chimney.

Clip Course. The course of brick resting on a clip joint.

Clip Joint. A joint of abnormal thickness to bring the course up to the required height. In no case should a clip joint be over ½ in. thick.

Closer. A piece of brick laid to the line. Also the last brick laid in any course of any tier.

Closure. A quarter or three-quarter brick to close, when required, the end of a course, as distinguished from a half-brick. This term equally applies to tile.

Code (Building). A set of laws or regulations governing the location, materials, and workmanship in the construction of buildings.

Column. A round pillar designed to support portions of a building, or to give such an appearance for ornamental purposes.

Common American Bond. The bond in which every seventh course is a heading course.

Common Bond. Several courses of stretchers followed by one course of either Flemish or full headers.

Common Brickwork. The wall built out of the ordinary and cheaper classes of brick, where appearance is not an important consideration.

Compasses. The instruments for making circles or parts of circles used in striking an arch.

Consistency of Mortar. The character of the "make up" of mortar.

Coping. A row of brick, usually projecting, used to cap or finish the top of a wall and protect it from the weather. It is usually laid up in very rich Portland cement mortar with tooled joints.

Corbel. One or more courses of brick projecting from the wall to form a support.

Corbel Out. To build out one or more courses of brick or stone from the face of a wall, to form a support for timbers.

Corbel Table. A projecting cornice or parapet, supported by a range of corbels a short distance apart, which carry a molding above which is a plain piece of projecting wall forming a parapet, and covered by a coping. Sometimes small arches are thrown across from corbel to corbel, to carry the projection.

Core of Chimney. The inside shell of the chimney.

Cornice. The projection at the top of a wall finished by a blocking-course, common in classic architecture. In Norman times, the wall finished with a corbel table, which carried a portion of a plain projecting work, which was finished by a coping and the whole formed a parapet. In Early English

times the parapet was much the same, but the work was executed in a much better way, especially the small arches connecting the corbels. In the Decorated period the corbel table was nearly abandoned, and a large hollow, with one or two subordinate moldings, substituted; this is sometimes filled with the ball-flowers, and sometimes with running foliages. In the perpendicular style the parapet frequently did not project beyond the wall-line below: the molding then became a string (though often improperly called a cornice) and was ornamented by a quatre-foil, or small rosettes, set at equal intervals immediately under the battlements. In many French examples the moulded string is very bold, and enriched with foliage ornaments.

Course. A horizontal row of brick in a wall.

Cove. The moulding called cavetto, or the scotia inverted on a large scale, and not as a mere molding in the composition of a cornice, is called a cove or a coving.

Cross Joint. The joint between the two ends of the brick.

Crowding the Line. Laying the line bricks in such a way as to prevent the line or string from being clear of the face of the brickwork. In other words, building with a tendency to make the wall overhang.

Crown is the highest point of the arch.

Culling. Sorting brick for size, color, and quality.

Culls. The brick rejected in culling.

Dentil. The cogged or toothed member, common in the bed-mould of a Corinthian entablature, is said to be dentiled, and each cog or tooth is called a dentil.

Depressed Arches or Drop Arches. Those of less pitch than the equilateral.

Diagonal Bond. A form of raking bond where the bricks are laid in an oblique direction in the center of a thick wall, or in paving.

Diaper. Any continuous pattern in brickwork of which the various bonds are examples. It is usually applied, however, to diamond or other diagonal patterns.

Discharging or Relieving Arch. The arch which is built over a lintel to relieve the pressure of the wall above.

Dutch Arch. A flat arch whose voussoirs are laid parallel to the skewback on each side of the center.

Dutch Bond. The arrangement of bricks forming a modification of Old

English bond, made by introducing a header as the second brick in every alternate stretching course. with a three quarter brick beginning the other stretching courses.

Eastern Method. The pick and dip.

Edgeset. A brick set on its narrow side instead of on its flat side.

Efflorescence. The deposition of a white powder or crust on the surface of brickwork, due to soluble salts usually in the mortar but sometimes in the brick, and, drawn out with the moisture by the sun, left as a deposit on the surface. Brick clays containing these salts are now cured by using a carbonate of barium. Against mortar efflorescence care should be taken to protect all brickwork at eaves and sill courses from excessive moisture.

Egyptians. The natives of Egypt, who live mainly along the banks of the river Nile, and whose civilization was in a high state of development 5000 years before the birth of Christ.

Elliptical Arch. A semi-circular arch whose crown is depressed, showing its span correspondingly lengthened, to approximate more nearly the appearance of a segmental arch.

Embattlement. An indented parapet—battlement.

Encaustic Tile. Tile prepared by burning in certain preparations for particular effects.

English Bond. Usually called old English bond, the bond which is made by alternate courses of stretchers and headers, with a 2 inch piece or closer next to the corner header.

English Cross Bond. A variation of English bond made by putting one header next to the corner stretcher on alternate stretching courses.

Extrados is the outer or upper surface of the arch, sometimes called the back.

Face. The long, narrow side of a brick, specially treated in the manufacture of face brick to produce certain color-tones and textures.

Face Brick. A well-burned brick, especially prepared, selected, and handled to secure attractive appearance in the face of a wall.

Fat Mortar. A sticky mortar which usually has an insufficient amount of sand.

Filling In. The process of building in the center of the wall between the face and back.

Fire Clay. A grade of clay that can stand a terrific amount of heat without softening or burning up; therefore used for fire bricks.

Fire Stop. A projection of brickwork on the walls between the joists to prevent the spread of fire or vermin.

Flat Arch. Is that arch whose top and bottom are flat or practically so. It involves the same principles of stress and strain as a segmental arch, but has the voussoir extended up and down to reach the level lines.

Flat Stretcher Course. A course of stretchers set on edge and exposing their flat sides on the surface of the wall. Frequently done with brick finished for the purpose on the flat side, such as enameled or glazed brick.

Flemish Bond. The arrangement of bricks made by alternating headers and stretchers in each course. The position of each header is in the center of the stretcher above and below.

Flemish Bond (Double). The arrangement of the bricks which gives Flemish bond on both sides of the wall.

Flemish Cross Bond. Any bond having alternate courses of Flemish headers and stretcher courses. The Flemish headers being plumb over each other and the alternate stretcher courses being crosses over each other.

Flemish Double Cross Bond. Bond with odd numbered courses stretchers divided evenly over each other, and even numbered courses Flemish headers in various locations with reference to the plumb of each other.

Flemish Garden Bond. Bricks laid so that each course has a header to every three or four stretchers.

Flue. A passage in a chimney especially for the exit of smoke and gases, one or more of which may be enclosed in the same chimney.

Flue Lining. A smooth one-celled hollow tile for protecting flues.

Flushed. Filled up to the surface.

Footing. The broadened base of a foundation wall, or other superstructure.

Full Header. A course consisting of all headers.

Frame High. The height of the top of the window or door frames; the level at which the lintel is to be laid.

Furring. A lining or covering to make a level surface.

Garden Wall Bond. A name given to any bond particularly adapted to walls two tiers thick. A bond consisting of one header to three stretchers in every course.

Gauge. To gauge is to measure for a particular purpose. Some tools for particular measurement may be termed a gauge; as, for example, a "gauge stick" with courses of brick marked thereon.

Gingerbread Work. To work with cheap decorations without any respect to their fitness.

Glazed Tile. Tile which is finished with a glass like surface.

Gothic Arch. A pointed arch made up of two segments whose points meet at the crown.

Green Brickwork. Brickwork in which the mortar has not yet set.

Grout. Rich mortar made very thin so that it will readily run into the joints of brickwork and fill them.

Hand Leather. A piece of leather used to protect the fingers.

Hard. A term given to the brick that are thoroughly baked.

Haunch is the name applied to the middle part of each side of the arch, *i.e.*, midway between the skewback and the crown.

Header. A brick laid on its flat side across the thickness of the wall, so as to show the end of the brick on the surface of the wall.

Header Bond. Bond showing only headers on the face, each header divided evenly on the header under it.

Header Course. A course composed entirely of headers.

Header High. The height up to the top of the course directly under a header course.

Head Joint. A joint between the ends of two bricks in the same course. Also *Vertical Joint*.

Hearth. That portion of a fire place level with the floor, upon which the fire is built. The rear portion extending into the fire opening is known as the back hearth.

Head-Way. Clear space or height under an arch, or over a stairway and the like.

Herringbone Bond. Bricks laid in an angular or zigzag fashion, resembling the bone in a herring.

Imperviousness. The quality of resisting moisture.

Initial Set. The first setting action of mortar; the beginning of the set.

Interlocking. The binding of particles one with another.

Inverted Arches. Arches which are built to appear upside down; made to distribute the weight from pier to pier; over an extended surface of the foundation bottom.

Jack Arch. A flat arch.

Jamb. The side of an opening, such as a window or door.

Jamb-Shafts. Small shafts to doors and windows with caps and bases; when in the inside arris of the jamb of a window, they are sometimes called Esconsons.

Jointer. A tool used for smoothing or indenting the surface of a mortar joint.

Jointing. The process of facing the mortar joints.

Key. The relative position of the headers of various courses with reference to a vertical line.

Keystone or Brick. The center brick of the arch.

Lap. The distance one brick extends over another.

Lateral Thrust. The pressure of a load which extends to the sides.

Laying Overhand. Building the further face of the wall from a scaffold on the other side of the wall. Laying the outside face tier from the inside of the building.

Laying to Bond. Laying the brick of the entire course without a cut brick.

Lead. A part of the wall at the corners, or elsewhere when needed, built in advance of the rest of the wall as a guide to which the line is attached.

Lean Mortar. Mortar that does not adhere to the trowel, generally due to the presence of too much sand.

Light Hard. A term applied to red brick that are not the hardest in the kiln. Although suitable for carrying moderate loads, they are not able to withstand alternate freezing and thawing as well as the hard brick.

Lime. The base of mortar, and the result of limestone burned in a kiln until the carbon dioxide has been driven off.

Lime Putty. Slaked lime in a soft putty-like condition before sand or cement is added.

Line. The string stretched taut from lead to lead as a guide for laying the top edge of a brick course.

Lineal Foot. A foot measurement along a straight line.

Line of Demarcation. The line of separation; the division point.

Lintel. A horizontal support for brickwork over an opening.

Lipped. Laid with a battering face.

Manganese. A mineral contained in the clay for brickmaking.

Mantel. A shelf projecting beyond the chimney breast above the fireplace opening.

Merlon. That part of a parapet which lies between two embrasures.

Mortar. A mixture of lime and sand, or cement and sand, or of lime, cement and sand, used for laying bricks and filling in the joints between them.

Mortar Board. A board about 3 feet square laid on the scaffold to receive the mortar ready for the use of the bricklayer.

Mortar Box. The box in which the mortar is mixed and softened by water for use.

Neat Cement. Pure Portland cement, which is used as a mortar without adding sand.

Nogging. A filling of brick between the roof rafters from wall plate to roof boards for the purpose of making the building wind-tight.

Offset. A course that sets in from the course directly under it. Also called set-off, set-back, etc. The opposite of corbel.

Outrigger. A joist projecting out of a window for supporting an outside scaffold.

Outside Four Inches. The single tier of stretcher courses on the face of the wall.

Overhand Work. An entire wall built with a staging located on only one side of the wall.

Overhang. A face of the wall leaning from the vertical away from the wall.

Panel. A distinct or blocked out portion or section of a wall or some other surface

Parapet. A dwarf wall along the edge of a roof, or round a terrace walk, etc., to prevent persons falling over, and as a protection to the defenders in case of a siege. Parapets are either plain, embattled, perforated or paneled. The last two are found in all styles except the Norman. Plain parapets are simply portions of the wall generally overhanging a little, with opening at the top and corbel table below. Embattled parapets are sometimes paneled, but oftener pierced for the discharge of arrows, etc. Perforated parapets are pierced in various devices—as circles, trefoils, quatrefoils, and other designs—so that the light is seen through. Paneled parapets are those ornamented by a series of panels, either oblong or square, and more or less enriched, but are not perforated. These are common in the Decorated and Perpendicular periods.

Pargeting. A term meaning the process of plastering the inside of a chimney flue.

Party Walls. Partitions of brick or stone between buildings on two adjoining properties.

Peach Basket. A templet against which the entire head of a tall chimney is built.

Peen. That end of a hammer head which terminates in an edge.

Perpends. The vertical joints in the face of the wall when corresponding joints are plumb one over the other.

Pick and Dip. The name of the method where the bricklayer picks up a brick with one hand, and just mortar enough to lay it with a trowel with the other hand, simultaneously.

Pier. A block of brickwork usually between two openings which is built to support arches, or to carry beams or girders.

Pilaster. A pillar of brickwork, rectangular in form, built as a supplement to a pier, projecting usually one-third of the thickness of the wall.

Plastic. In the form of a sticky paste.

Plinth. The square block at the base of a column or pedestal. In a wall, the term plinth is applied to the projecting base or water table, generally at the level of the first floor.

Plumb Bob. The lead weight to make taut the plumb line.

Plumb Bond. Another name for all stretcher bondwork built with particular effort to have corresponding joints exactly plumb with each other.

Plumb Bond Pole. A pole used for laying out the exact position of vertical joints.

Plumb Rule. A tool used to aid in building surfaces in a vertical plane.

Pointing. Inserting mortar into the joints after the brickwork is completed, in order to correct defects left in the progress of the work.

Pointing Trowel.—A small tool used for filling joints on the exposed surface of the wall.

Portland Cement. That cement made by a mixture of various clays, chalk, limestone, river mud, slate and the like, which are mixed together, burned, then ground into a powder and put through a sieve with fine meshes.

Pressed Bricks. Those that are pressed in the mould by mechanical power before they are burned or baked.

Pugging. A coarse kind of mortar laid on the boarding, between floor joists, to prevent the passage of sound; also called deafening.

Putlog. The cross supports of the scaffold which hold the scaffold planks or platform.

Queen Closer. A half brick made by cutting the brick lengthwise.

Quoins. Projecting courses of brick at the corners of buildings as ornamental features.

Racking. Laying the end of the wall with a series of steps so that when work is resumed, the bond can be easily continued. More convenient and structurally better than toothing.

Rake. The end of a wall that racks back.

Raking Bond. Brick laid in an angular or zigzag fashion.

Reenforced Concrete. Concrete which has iron and steel rods and pieces to enable it to withstand greater stress and strain.

Recess. A depth of some inches in the thickness of a wall, as a niche, etc.

Reveal. The vertical side of a window or door opening from face of wall to frame.

Rise. The distance at the middle of the arch between the springing line and intrados or soffit.

Rolled. A brick laid with an overhanging face.

Routing. Determining the way, the time and the method of getting materials from the point of shipment to the place where the workman puts them in place.

Rowlock. Rows of bricks on edge, particularly for the ring of an arch.

Rowlock Course. A course of headers laid on the edge instead of on the flat side of the brick as usual.

Run. Planks used for workman to walk on.

Running Bond. Same as stretcher bond.

Run of Kiln. All brick in the kiln except those brick that are too soft or misshapen to be laid even in the filing tiers.

Sag. A depression in a horizontal line, meaning that there is a slight fall below the level. Usually refers to the bricklayer's line, which in a long distance will fall below the level because of its own weight, no matter how tightly it is stretched.

Salamander. A heater having no chimney.

Salmon Brick. The softer brick of the kiln suitable for places protected from outside exposure or where great crushing strength is not required.

Sand. Small grain of mineral, largely quartz, which is the result of disintegration of rock.

Scaffold Height. The height of the wall which requires another raising of the scaffold to continue the building of the wall.

Scale Box. A derrick box made with an open top and one open end.

Scant. A slight slope inwards from the plumb line.

Scutch. A tool resembling a pick on a small scale with flat cutting edges, for trimming bricks for particular uses.

Segmental Arch. An arch whose intrados and extrados make the line of a half circle.

Selects. The bricks accepted as the best after culling.

Set. A name given for the chisel used for cutting bricks, also a "bolster."

Set In. The amount that the lower edge of a brick on the face tier is back from the line of the top edge of the brick directly below it.

Set-off. Set in.

Shank. That part of the trowel between the blade and the handle or hold.

Shanking. Resting the hod on the end of the handle (or shank)

Shell of Chimney. The outer wall of a chimney.

Shove Joint. A vertical joint filled by shoving the brick, when it is being laid in the bed of mortar, against the next brick.

Silica. A mineral contained in the clay used for brickmaking.

Sill High. The height for the window sills upon which the window frame rests.

Skewback. In brickwork, a brick or stone cut to make an inclined surface for receiving thrust or pressure, as of an arch.

Slewing Rig. The device used for swinging a boom derrick by machinery.

Slush Joint. A vertical joint filled by throwing mortar in with the trowel after the bricks are laid.

Smoke Chamber. The space in a fire place immediately above the throat, where the smoke gathers before passing into the flue, and narrowed by corbeling to the size of the flue lining above.

Soffit. The lower edge or curve of the arch; also called "intrados."

Soldier Course. A course of stretchers set on end with the face showing on the wall surface.

Soluble Salts. A mineral contained in the clay for brickmaking.

Span. The distance to be covered by an arch, lintel, beam, girder or the like, between two abutments, or supports; the width of an opening.

Spandrel. The triangular portion of the wall contained between the arches when a horizontal line is drawn from crown to crown.

Spirit Plumb Rule. A plumb rule made by the insertion in the wood stock of small tubes filled with spirits with an air bubble which is arranged to center at a point when the rule is in a plumb position.

Splay. A slope or bevel, particularly at the sides of a window or door.

Spreading Mortar. The process of laying mortar on the wall with a trowel to make a bed in which to lay the brick.

Springer. The stone from which an arch springs; in some cases this is a capital, or impost; in other cases the moldings continue down the pier. The lowest stone of the gable is sometimes called a springer.

Springing Points. The points from which the under curves of the arc commence.

Spring Stay. A stay, made by two pieces of board separated by a brick which holds a scaffold to a wall by the friction caused by the spring of the boards.

Squint. An oblique opening in the wall of a church; especially in mediaeval architecture, an opening so placed as to afford a view of the high altar from the transept or aisles.

Stagings High. About 3′ 8″ with the Gilbreth Scaffold, about 5′ 0″ high with the trestle horse.

Stippling. That process of shading by making separate marks or points.

Stock. Brick and mortar.

Story High. The height for the floor joist.

Story Pole. A pole on which the height from joist to joist, as well as all intermediate openings, brick courses, etc., is indicated.

Straight Arch. A name for the jack, or flat arch.

Straight Edge. A board having an edge trued and straight, used for leveling and plumbing.

Stretcher. A brick laid on its flat side so as to show its face on the surface of the wall.

Stringing Mortar. The name of a method where a bricklayer picks up mortar for a large number of brick and spreads it before laying the brick.

Struck Joint. A joint that has the surface smoothed by a trowel.

Structural Steel. Steel beams, girders, and columns used for building purposes, particularly for high buildings, known as skyscrapers.

Superstructure. That part of a building which is above.

Tapping. Pounding a brick down into its bed of mortar with a trowel.

Temper. To mix up so as to get the mortar in the proper condition for use.

Tempering Mortar. Softening mortar by adding water and stirring.

Template. Any form or pattern, such as centering, over which brickwork may be formed.

Tender. A laborer who tends masons. A general name covering hod and pack carriers and wheel barrow men.

Texture of Brick. The looseness of compactness of the material of which the brick is made, which affects its appearance.

Thickness of Wall. The thickness of a wall stated in terms of brick, inches, or tiers, thus:

In Number of Brick	In Inches	In Tiers
One brick..................................	4″	1 tier
Two brick..................................	8″ or 9″	2 tiers
Three brick................................	12″ or 13″	3 tiers
Four brick.................................	16″ or 17″	4 tiers

Three-quarter. Means a brick with one end cut off; about a 6 inch piece.

Throat. An opening at the top of a fireplace through which the smoke passes to the smoke chamber and chimney.

Tier. One of the four-inch, or one-brick, layers in the thickness of a wall (Gilbreth).

Toother. A brick projecting from the end of a wall against which another wall will be built.

Toothing. The method of building the end of a wall so that the end stretcher of every alternate course projects one-half its length, against which another wall may be built.

Toothing-in. Joining a new wall to an old toothed wall.

Trestle Horse. A four-legged stool or trestle about five feet high, used to support platforms for scaffolding.

Trig. The bricks laid in the middle of the wall between the two main leads to overcome the sag in the line, and also to keep the center plumb in case there is a wind bearing upon the line.

Trimmer Arch. A brick arch built in front of and below a fire place opening to support the hearth, abutting on the fire place foundation and thrusting against the header joist.

Tub. A half-barrel sometimes used in New England for holding mortar.

Tuck Pointing. The filling in of joints in old brickwork with fresh mortar, usually cement.

Two Inch Piece. A closer about one-quarter of a brick in length use to start the bond from the corner.

Up and Down. The body brick together with the light hard brick.

Vertical Joint. Same as *head joint.*

Viaducts. An elevated roadway usually supported by masonry arches, or steel columns and trusses, in recent years often made of re-enforced concrete.

Vitrification. The state of a substance which is fused together by burning.

Vitrified. That which is fused by heat.

Voussoir. The unit brick, stone or block used in the building of an arch.

Wall Plate. A piece of timber usually 2″×4″ laid on the wall to receive the floor joists.

Wall Ties. Iron bands used to tie tiers of brick together or to tie the junction of two pieces of a wall, such as at corners, angles, and at toothing and backing.

Washing Down. Cleaning the surface of the brick wall, after it is completed and pointed, with a mild solution of muriatic acid.

Water Table. A slight projection of the lower courses of brickwork at the base of a building.

Weathering. The process of decay brought about by the effects of weather conditions.

Webb. The thin wall bounding and separating the cells in hollow tile.

Whitewashing, Whitewash. See *efflorescence.*

Wind Shelf. The ledge back of the damper at the bottom of the smoke cavern.

Wire Cut Brick. A brick having two of its surfaces formed by wires cutting the clay before it is baked.

Withe. A partition between two flues in the same chimney.

Western Method. The stringing mortar method.

Applying the Mortar.—The placing of the mortar before laying the brick consists of four distinct operations.

1. Throwing.
2. Spreading.
3. Cutting off.
4. Buttering end joint.
5. Jointing.

FIG. 3,957.—Assembly of bricklayer's tools. These are the main tools and it should be noted that there are numerous other tools to make a complete set for all kinds of work, as shown in Chapter 66.

FIGS. 3,958 and 3,959.—Picking up mortar.

Use of the Trowel.—The student of bricklaying must learn first how to handle the trowel in picking up, throwing and spreading mortar. The practical way for the apprentice to acquire this knowledge is to practice on the mortar board

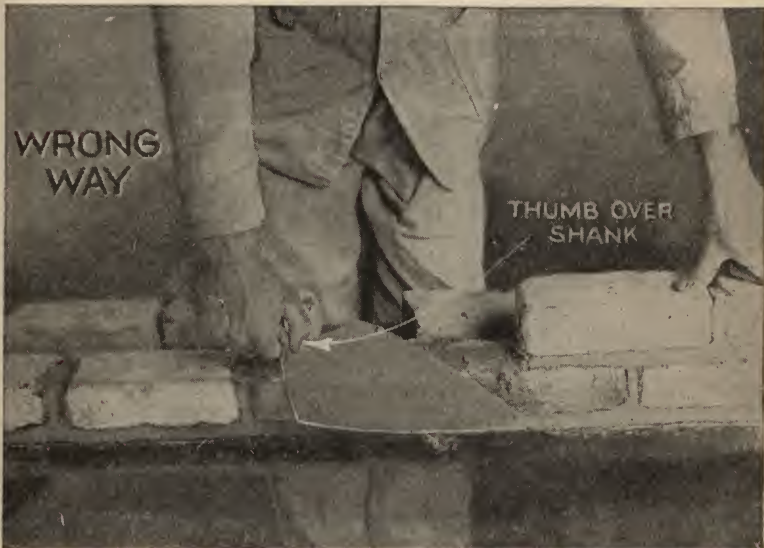


Fig. 3,960.—Holding trowel; *wrong way*—thumb over shank. The trowel should be held loosely, the reason the above is the wrong way is because the trowel should be turned by the thumb pressed against the ferrel. The forefinger should not be up against the shank.

Figs. 3,961 and 3,962.—Wrong and right way to hold the trowel. Evidently if the trowel were held as in fig. 3,961 it would be difficult or impossible to turn it upside down in spreading the mortar—try it.

during lunch periods and before working hours. In this practice he should learn how to pick up a trowelful of mortar cleanly, and to spread sufficient mortar to lay at least three brick with one trowelful of mortar; some bricklayers throw in one operation enough mortar to lay four or five brick, depending upon the thickness of the joint. Thickness varies from

FIG. 3,963.—Holding trowel; ***right way***—thumb on top of ferrel. Note position of thumb on ferrel, in which position the trowel is easily turned as the trowel is moved along the course of brick.

$\frac{1}{8}$ to $\frac{1}{2}$ in. according to the design worked out by the architect.

In order to use a trowel properly, it should be held firmly yet loosely, with the full grasp of the right hand and applied with the play of the muscles of the arm, wrist and fingers. Only actual practice can give the various necessary mechanical movements.

Throwing the Mortar.—Lifting a trowelful of mortar from the tub or mortar board up to the courses of brick on the wall and throwing the mortar the length of three or more brick is done with the muscles of the forearm.

In throwing the mortar, *the trowel is turned through an angle of* 180° (*that is, turned upside down*) ***while*** *the trowel is being moved the length of three or more brick.*

FIG. 3,964.—Throwing mortar—***1st position.*** Note trowel is being turned as it is moved along the brick.

In order to turn the trowel upside down, evidently it must be held as in fig. 3,962, because the hand, unlike an owl's head, does not work on a pivot, and 180° is about the limit it will turn without elevating the elbow.

Figs. 3,958 and 3,959 show how the mortar is "picked up" from the mortar board preliminary to throwing it on the brick.

FIG. 3,965.—Throwing mortar—***2nd position.*** The trowel is gradually moved along the brick and turned at the same time—the point of the trowel rides along the center of the brick course without touching it.

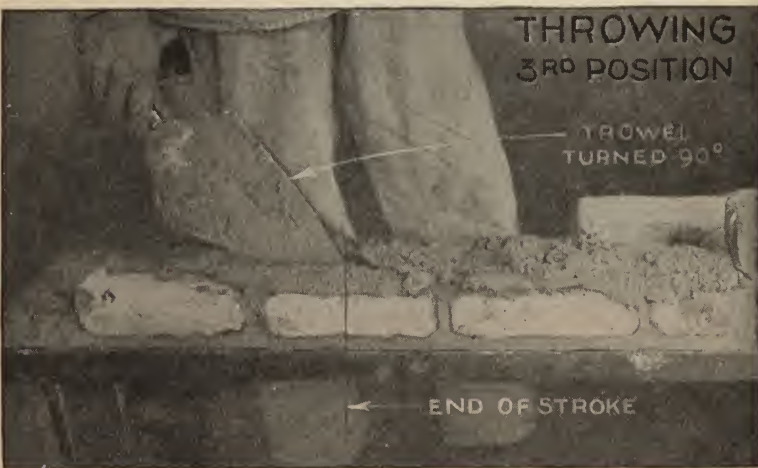
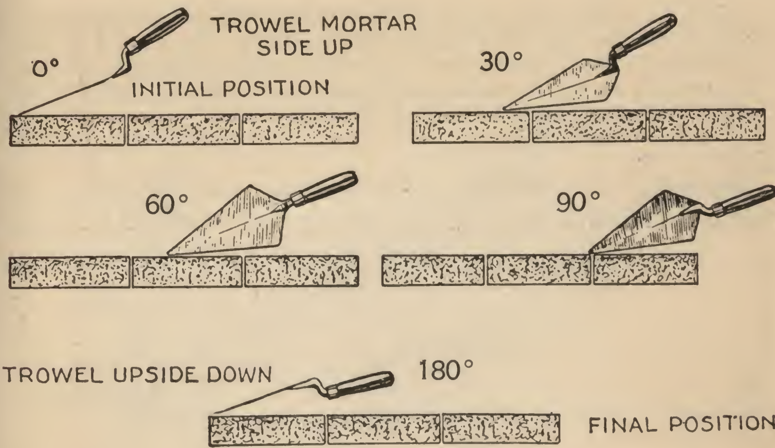


FIG. 3,966.—Throwing mortar—***3rd position.*** Completion of stroke—trowel in vertical plane. In bringing the trowel back and forth to spread the mortar, it is gradually turned upside down.



FIGS. 3,967 to 3,971.—*1.* ***Throwing the mortar.*** The operation as ideally performed by the bricklayer is here shown progressively from initial position to beginning of spreading stroke. Note that as the trowel is brought back for the spreading stroke it is turned upside down.

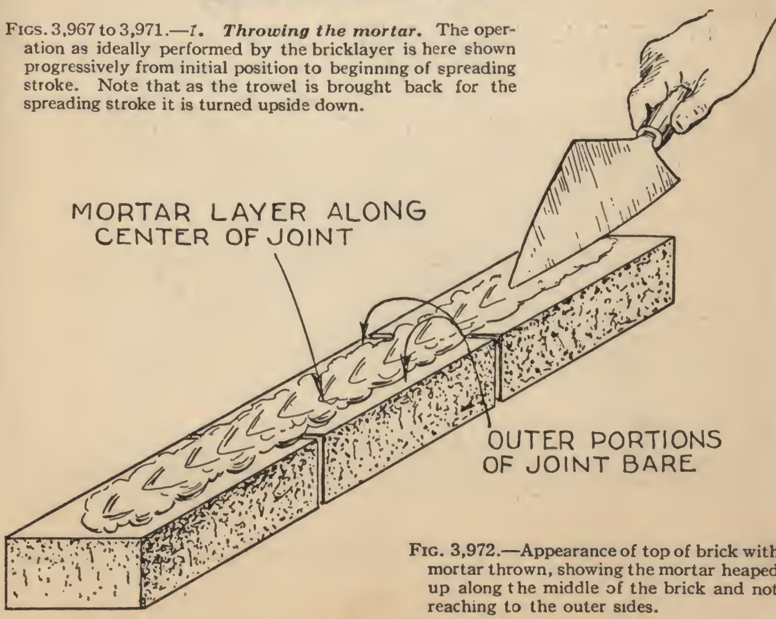


FIG. 3,972.—Appearance of top of brick with mortar thrown, showing the mortar heaped up along the middle of the brick and not reaching to the outer sides.

In order to fully understand how the bricklayer throws the mortar, the operation is first shown by the diagrams figs. 3,967 to 3,971. Here only the trowel is shown without hand or mortar so its various positions may be seen as it travels the length of the spread or a three brick length as here taken and back again to begin the spreading stroke.

Spreading the Mortar.—The operation of throwing the mortar results in a rounded column of mortar along the central

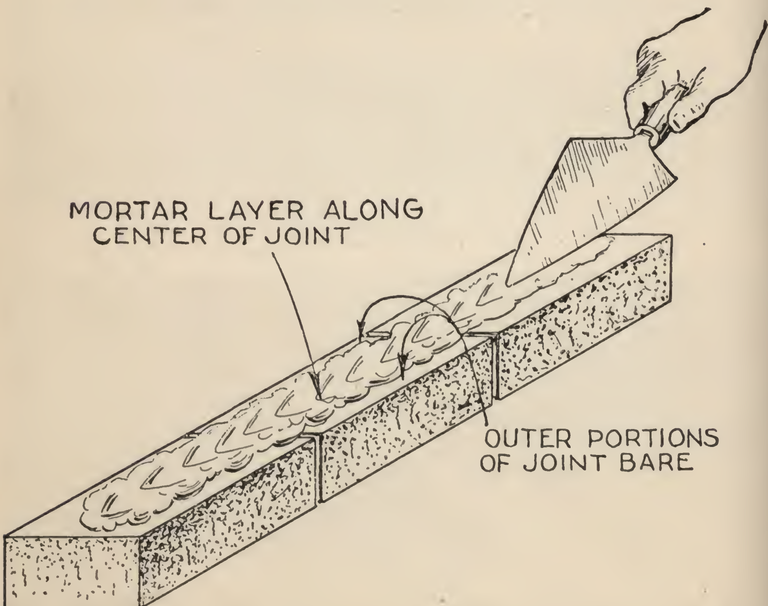
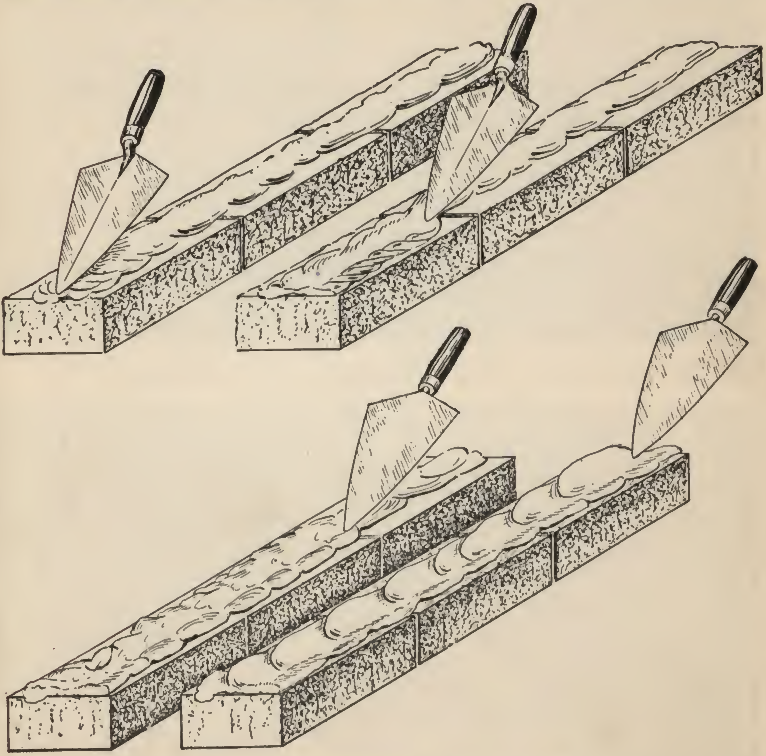


FIG. 3,973.—Appearance of mortar after throwing—note that it is heaped up along the central portion of the brick course outer portions bare.

portion of the brick leaving the outside portions bare, as shown in fig. 3,973.

In order that the brick shall have a full bed of mortar to lie on so that the load will be distributed over its entire face, the mortar after being thrown (as in fig. 3,972) should be



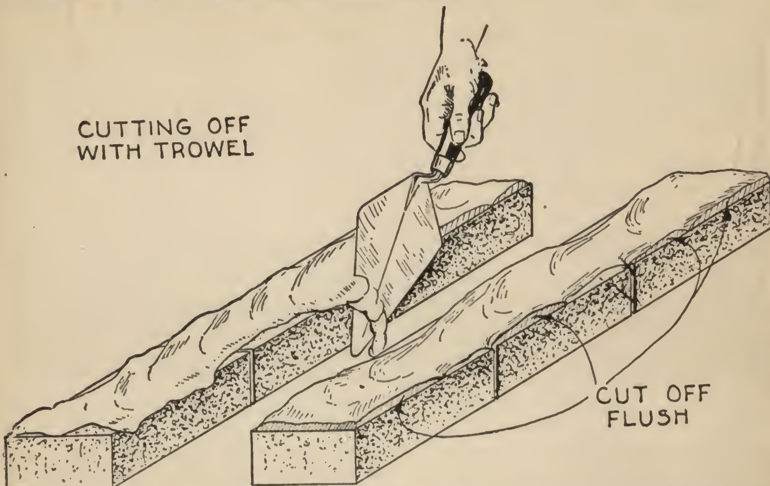
FIGS. 3,974 to 3,977.—*2. Spreading the mortar.* By gently pressing the point of the trowel on the column of mortar already thrown, the blade of the trowel being at a very acute angle with the top of the brick, as the trowel is moved along the brick, the mortar heaped up along the middle is squeezed out toward the edges and thus made to cover the entire surface or as near so as possible.

spreads by going over it with the point of the trowel as in figs. 3,974 to 3,977.

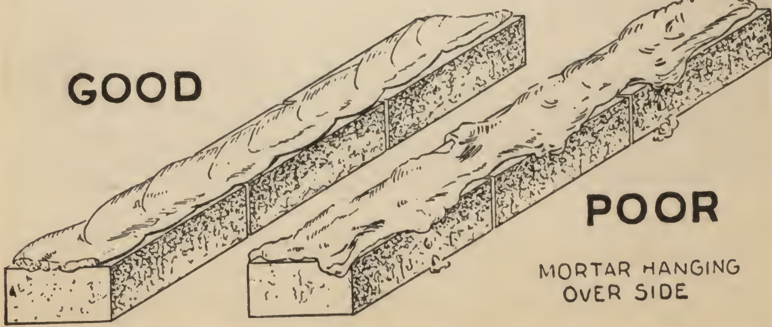
FIG. 3,978.—Spreading mortar—*1st position.* It should be done with the point of the trowel. with the trowel upside down. Note difference between mortar as laid and as spread.

FIG. 3,979.—Spreading mortar—*2nd position.* End of stroke. Note mortar spread out toward the sides of the brick hollow in center keeping mortar flush with sides, also note position of trowel at a small angle (about 45°) with face of brick.

The position of the trowel in spreading is shown in figs. 3,967 to 3,971 and the actual operation of spreading the mortar as performed by a bricklayer is progressively shown in figs. 3,978 and 3,979.



FIGS. 3,980 and 3,981—Appearance of perfect and imperfect spread. Note in fig. 3,981, mortar overhanging which must be cut off before brick is laid, thus necessitating an extra operation with loss of time.



FIGS. 3,982 and 3,983—Appearance of mortar before and after being cut off. Note all overhanging mortar is cut off flush with the face of the brick.

Cutting Off the Mortar.—When the operation of spreading the mortar has been perfectly done as in fig. 3,980, no cutting off is necessary. If, however, too much mortar were thrown, or too much pressure exerted on the trowel in spreading the mortar, some of it will hang over the side of the brick as shown in fig. 3,981, and must be *cut off* so that it will not at any point project over the side of the brick. The appearance of the mortar before and after being cut off is shown in figs. 3,985 and 3,986.

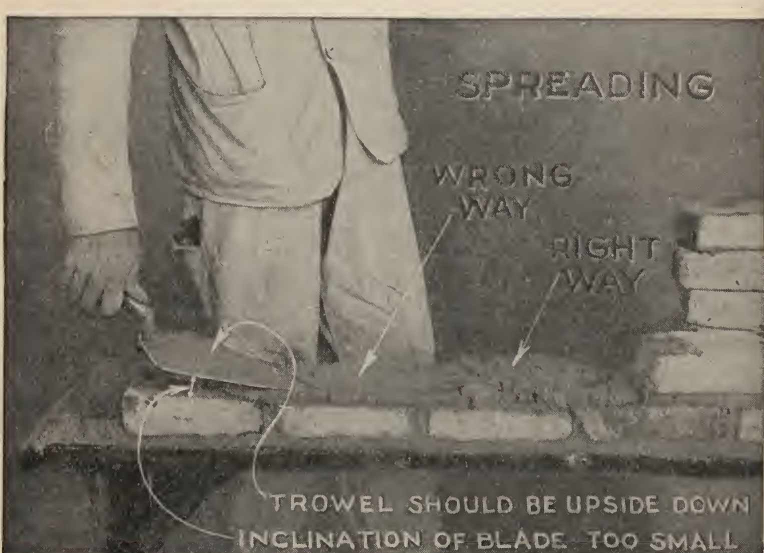


FIG. 3,984.—Spreading mortar, ***right*** and ***wrong way.*** The trowel should not be held as shown, but should be upside down—that is with back up. Note difference in appearance of mortar laid right and wrong way.

Buttering End Joints.—In addition to laying a bed of mortar for the brick to lie on, the end of each brick when laid must be covered or "buttered" with mortar so there will be

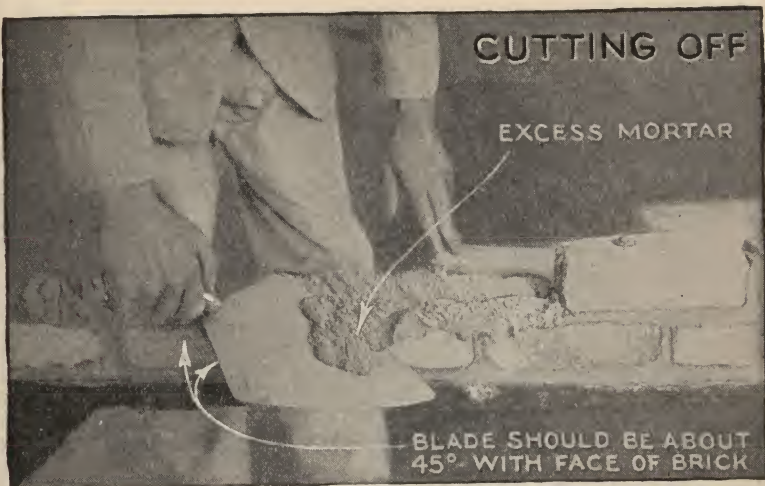
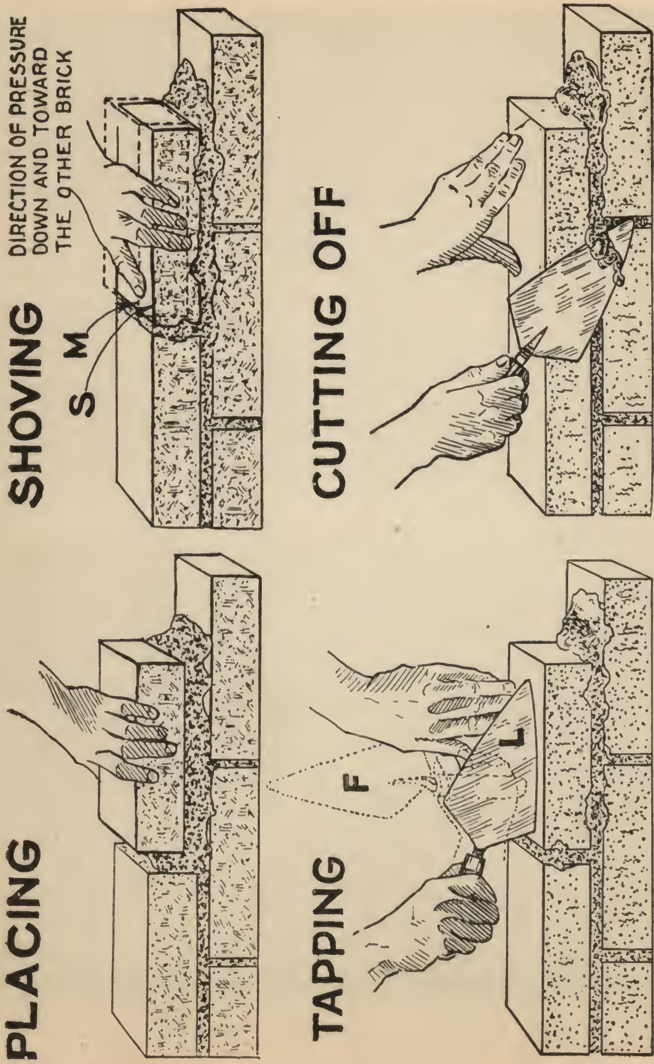


FIG. 3,985.—Cutting off excess mortar. Note position of trowel at a small angle (about 45°) with face of brick.

FIG. 3,986.—Removing excess mortar and "buttering" or putting it on the end of brick already laid for cross joint.



FIGS. 3,987 to 3,990.—Laying a brick by the shoving method. Fig. 3,987, placing the brick; fig. 3,988, shoving it down and toward the end of the other brick; fig. 3,989, tapping brick to final position; fig. 3,990, cutting off overhanging mortar.

a layer of mortar in the vertical joints as well as in the horizontal joints.

The operation of buttering the end joint is shown in fig. 3,986.

Laying the Brick.—In lifting a brick from the pile on the ground or scaffold in order to place it on its bed of mortar

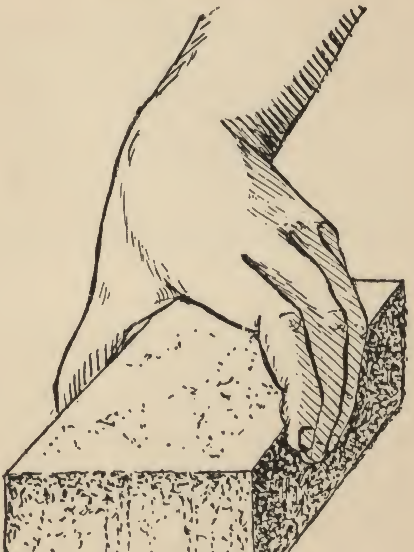


FIG. 3,991.—Picking up brick with the left hand.

on the wall, the bricklayer grasps it in his left hand, as shown in fig. 3,991, and in "laying" the brick, first places it on top the bed of mortar (previously spread) a little in advance (to the right) of its final position as shown in fig. 3,987, and presses the brick into the mortar *with a downward slanting motion* as indicated by positions M,S, in fig. 3,988, so as to press the mortar

FIG. 3,992.—Brick laying—*1st position.* The brick is held in hand with thumb on one side—forefinger on top and other three fingers on other side of brick—palm of hand on brick.

FIG. 3,993.—Brick laying—*2nd position.* Brick being pressed down and pushed against the other brick at the same time.

up into the end joint; during this operation the brick moves from its initial position M, shown in dotted lines M, (corresponding to the position shown in fig. 3,987) to some intermediate position S, fig. 3,988.

This is the shoving method of bricklaying, and if the mortar be not too stiff and is thrown into the space between the inner and outer courses of

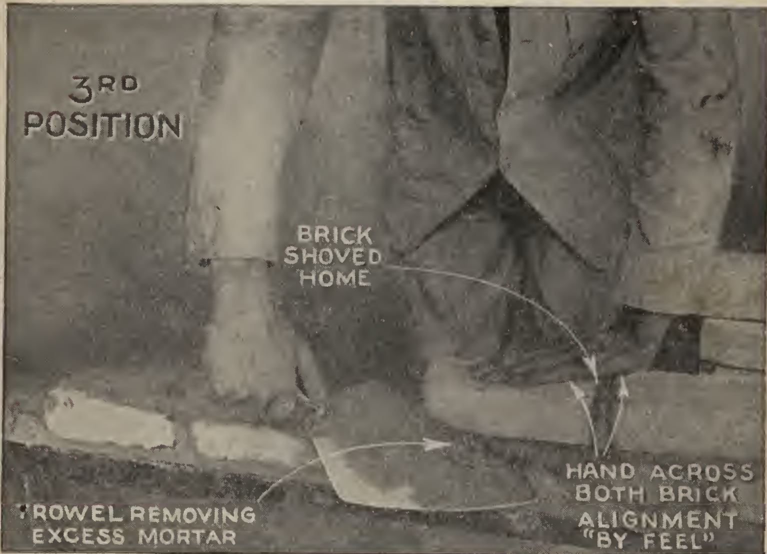


FIG. 3,994.—Brick laying—***3rd position.*** Brick shoved home with palm of hand across both brick so as to determine by the "feel" if both brick being laid and the one last already laid be in line. Note that excess mortar is being cut off at the same time.

brick with some force, it will completely fill the upper part of the joints not filled by the shoving process.

After shoving the brick down and against the mortar in the end joint, it is forced home, or down till it aligns with the brick previously laid by tapping it either with the blade of

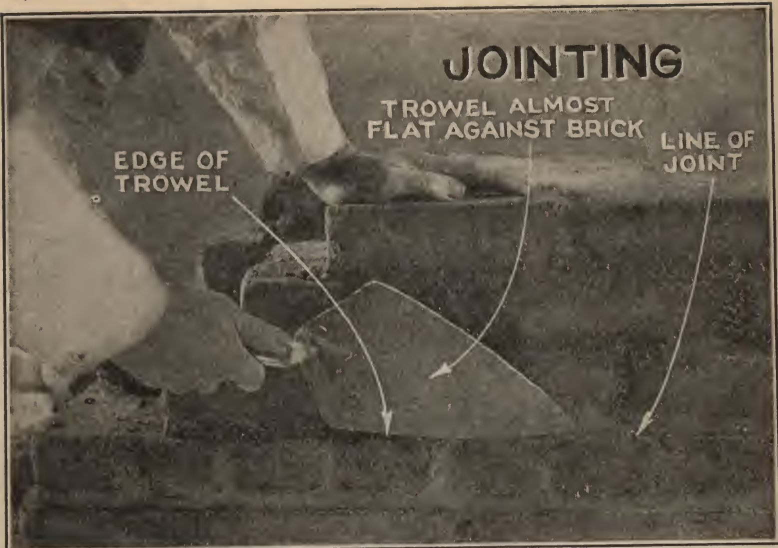


FIG. 3,995.—Method of jointing with blade of trowel.

FIG. 3,996.—Tapping, or knocking down brick to level of lime, where brick is high because of excess mortar. ***A first-class brick layer*** will rarely resort to tapping. It is sometimes done though ill-advisedly, through force of habit.

the trowel as shown at L, fig. 3,989, or with the stick with trowel in position F, shown in dotted lines.

Tapping brick down with the trowel should not be necessary if the mortar be of the right consistency, the brick wet enough, and the joints the right size. If tapping be necessary, give the brick one heavy tap rather than several light ones.*

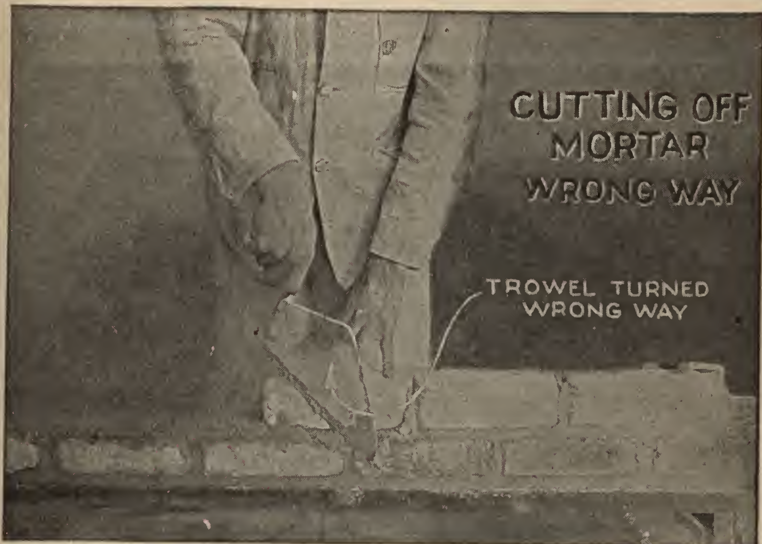


FIG. 3,997.—*Wrong way* of cutting off mortar. The trowel should not be turned with face toward brick as shown, but should be turned with back of trowel toward brick and held with handle about 45° to the vertical and blade about 45° with face of brick.

During the operation just described more or less of the mortar is squeezed out through the face and end joints as shown in fig. 3,989. For appearance and to save mortar it

*NOTE.—Nearly all bricklayers tap the brick from habit, not because it is necessary.

is cut off flush with the trowel as in fig. 3,990. This mortar on the trowel thus cut off should be used for buttering the end of the brick. It should never be thrown from the trowel back onto the mortar board. When thrown back onto the mortar board, a large portion daubs up the brick instead of landing on the board, and the operation results in an unnecessary motion each time.

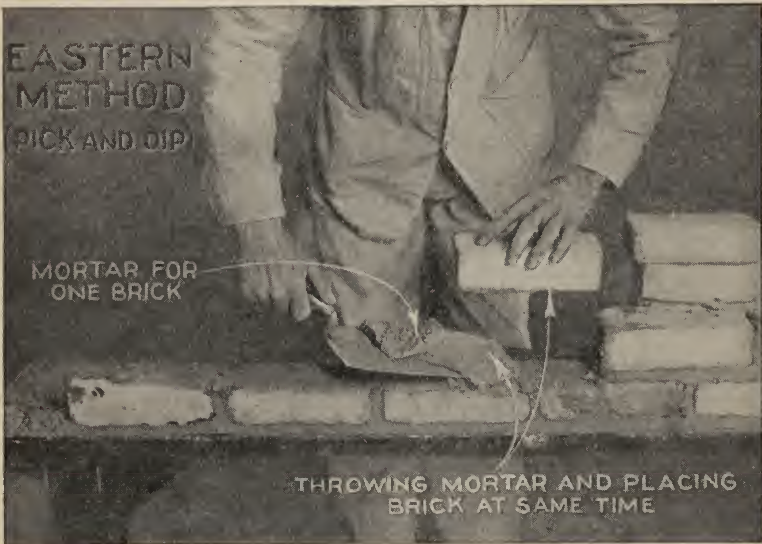


FIG. 3,998.—Pick and dip method, also called Eastern or New England method. Bricklayer picks up brick and mortar at same time, taking on the trowel only enough mortar to lay one brick. It is used for general working.

Eastern and Western Methods of Bricklaying.—In the Eastern method the brick is picked up and trowel dipped into the mortar at the same time, hence is known as the *pick and dip* method.

In this method, when the student reaches for mortar with one hand

and brick with the other, teach him to pick up both at the same time. He should look at the mortar as he starts to reach for it, but he should pick it up by the feeling, and his eyes should be only on the brick that he is picking up with the other hand at the same time, as shown in fig 3,998.

The "Western" or "stringing mortar" method is to use a much larger trowel than could be used in a tub This necessitates a mortar board or mortar box. This western method consist in first spreading mortar enough for several brick ahead, and then picking up and laying the brick.

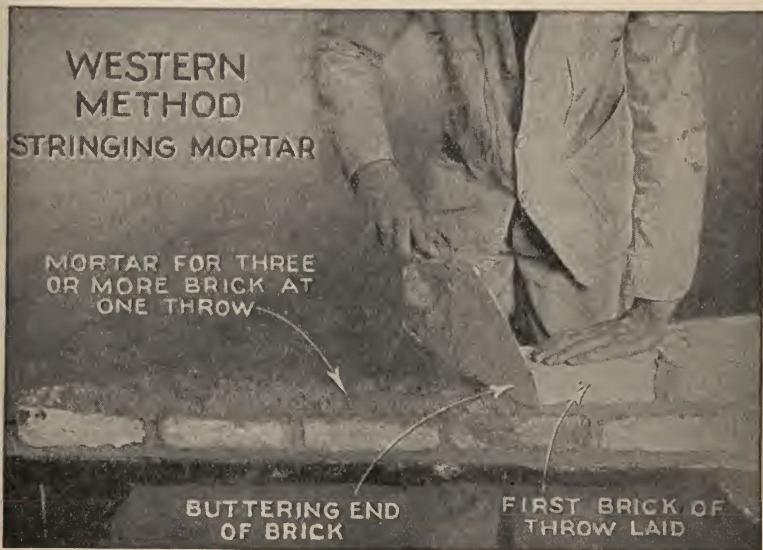


FIG. 3,999.—Western method or method of laying mortar for several brick at one throw Mortar is thrown for 3 to 5 brick, depending on the kind of brick and consistency of mortar.

When an apprentice reaches to pick up bricks, see that he picks them up with both hands at precisely the same time.

Each method has its advantages and disadvantages. Some conditions make the "Eastern" method preferable, some the "Western" method.

If the apprentice be taught both methods, he will know, instinctively,

which is the better to use under varying conditions. The kind of sand, the proportions of the cement, lime and sand, the dryness of the brick, the methods employed by the men on the leads, all these go to determine which method will give the most speed. economy and quality.

Alignment of Brick.—Evidently if no guide be provided and the brick be laid by eye, a true wall surface could not be obtained, as some of the brick would be laid too far out and others not enough. In order to guide the bricklayer so that the brick will lie straight, a taut line secured by pins is used, or the equivalent.

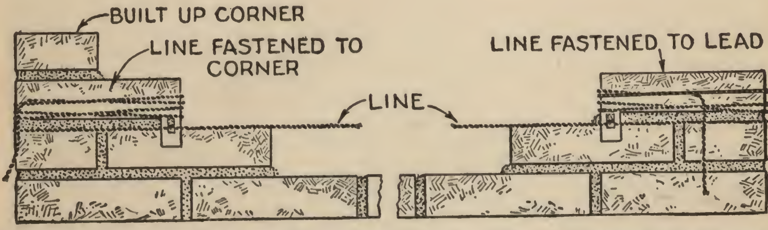


FIG. 4,000.—Safe method of fastening line around corner and lead. To fasten the line around the corner and lead, take several clove hitches around each.

In order to have supports for the line, a corner of the wall is first built up several courses and then a lead or a part in advance at some distance along the course.

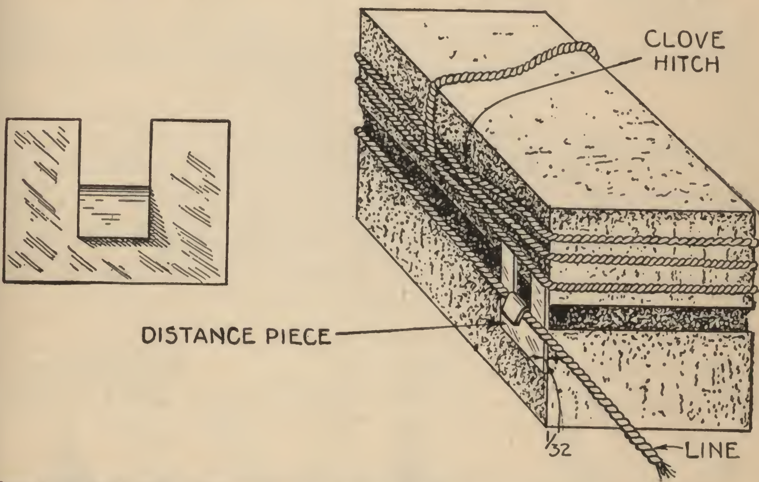
The line is made fast around the end or corner, stretched taut and wound around a brick on the lead, as shown in fig. 4,000. This is better than using a nail or pins because if the latter pull loose, the nail may hit a bricklayer in the eye, resulting in injury or loss of eye.

The line should be placed 1/32 in. outside the top edge of the brick and exactly level with it. In order to hold the line at 1/32 in. distance outside the top edge, make two distance pieces out of cardboard or preferably tin, shaped as in fig. 4,001 and attached to the line as in fig. 4,002.

The reason for this offsetting of the line is that the brick should be laid without touching the line, as in fig. 4,002 the 1/32 in. marginal distance being gauged by eye.

Obviously, if the brick were laid so that they touch the line, the latter would be shoved out of place, resulting in irregularities in the wall, as in fig. 4,004. Hence, see *that no brick touches the line.*

The tendency of inexperienced bricklayers is to "crowd the line" or as it is called laying brick *strong* on the line. This effort to work with precision does not accomplish the desired result for the reason just given.



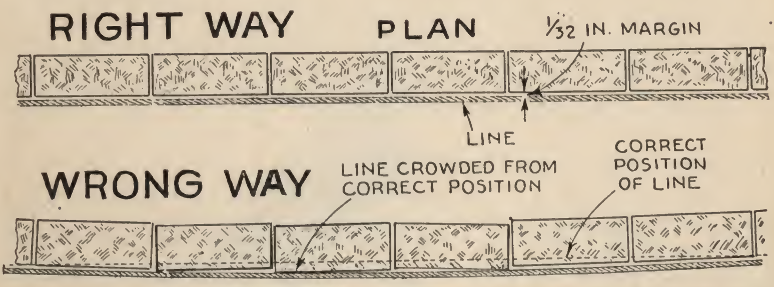
Figs. 4,001 and 4,002.—Distance piece for holding the line at a marginal distance from the edge of the brick.

The student who works with precision will not be satisfied with the instruction to set the line level with the top face of the brick, but will want to know whether the top or bottom of the line should be level with the top of the brick, especially if it be a thick line. Of course, bricklaying is not a machinist's job and one is not expected to work with machinist's precision, however precision methods cannot be criticised when they can be used without any extra effort or loss of time.

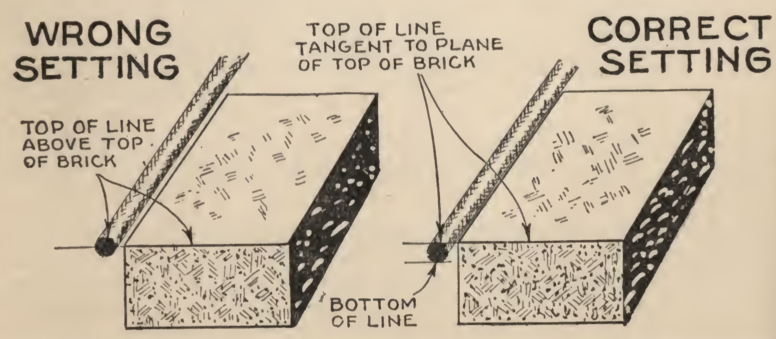
Figs. 4,005 and 4,006 show wrong and right ways to set the line when precision is considered.

In fig. 4,003, the *top* of the line rather than the bottom should be set at the level of top of brick because both the top of the line and top of brick are visible, whereas the bottom of the line is not. Accordingly, with the setting shown in fig. 4,003, the eye can gauge when the brick is pushed or tapped to the level of the *top* of the line.

If the above be not clear, assume a clothes line or even a ship's hawser be used for the line.



FIGS 4,003 and 4,004.—Right and wrong way of laying brick to the line, showing result of crowding the line.



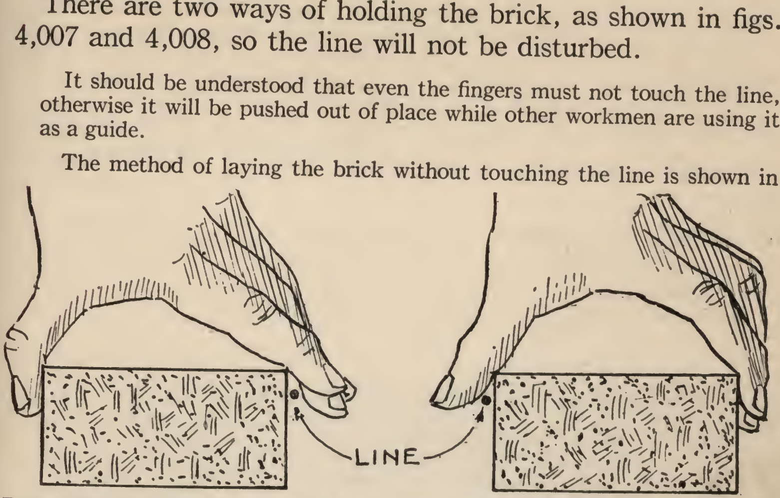
FIGS. 4,005 and 4,006.—Wrong and correct setting of the line. The size of the line is exaggerated for clearness.

A skillful bricklayer *will never touch the line even in applying the mortar or laying the brick.*

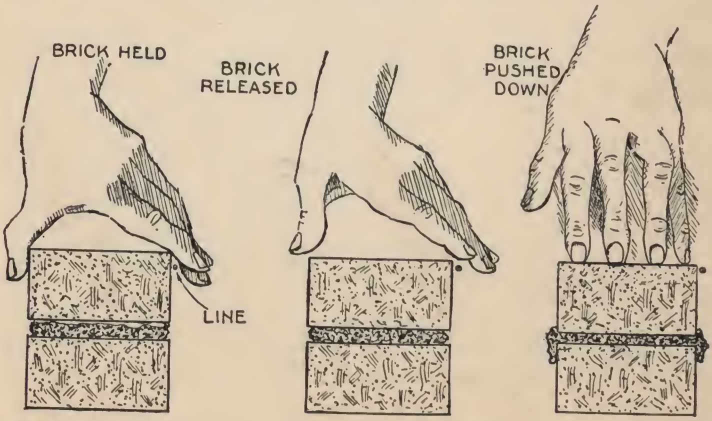
There are two ways of holding the brick, as shown in figs. 4,007 and 4,008, so the line will not be disturbed.

It should be understood that even the fingers must not touch the line, otherwise it will be pushed out of place while other workmen are using it as a guide.

The method of laying the brick without touching the line is shown in



FIGS. 4,007 and 4,008.—How to hold brick in laying so that the line will not be disturbed. Fig. ,4,007 line on outside; fig. 4,008, line inside.



FIGS. 4,009 to 4,011.—How to lay brick without touching the line. The brick is placed on top of the mortar as in fig. 4,009, holding it by the thumb and outstretched fingers. As the brick begins to bed by downward pressure release the hold as in fig. 4,010. Bring top of brick to level of *top* of line by pressing down with the fingers as in fig. 4,011 or by tapping if necessary.

figs. 4,009 to 4,011. Of course practice is necessary to do this successfully. The student should practice before laying to the line so that he will acquire the habit of bringing his thumb and fingers up as the brick goes down near the line.

Brick made in moulds are wider at the top or open side of the mould than at the bottom of the mould. The experienced

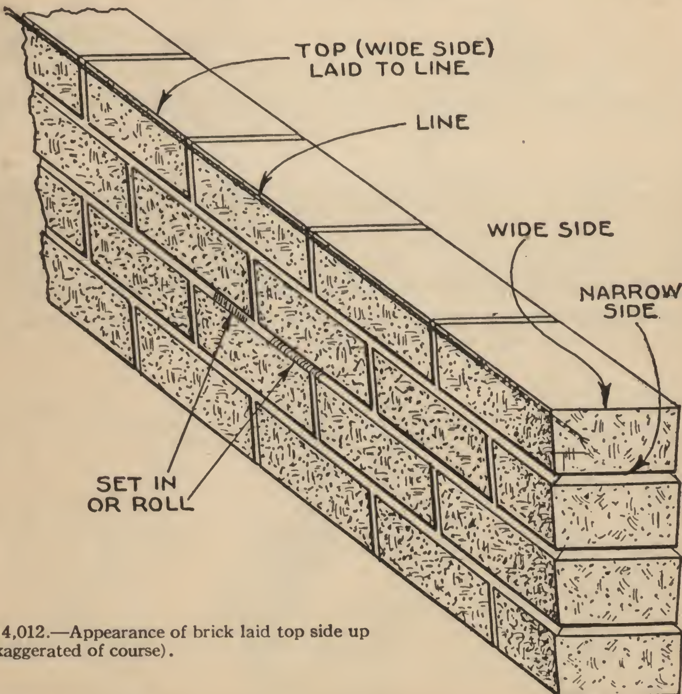


FIG. 4,012.—Appearance of brick laid top side up (exaggerated of course).

bricklayer can tell by the "feel" of the brick which is the wider side.

In laying brick to line for the outside or visible part of the wall, the brick should be laid with the wider side on top

so that the appearance of the wall will be similar to cla boards upside down, as in fig. 4,012.

Bricklayers from force of habit turn the brick over in the hand to dete mine the top or wider side, even for brick used in filling where it is n necessary. This results in loss of time and should not be done for invisit portions of the brick work.

Joints.—A difficulty experienced by beginners is to mainta a uniform thickness of the joints or spacing occupied by t mortar. The thickness of mortar joints ranges from ⅛ to ½ i or more to suit the kind of brick used and other conditions

Common brick should have at least $\frac{3}{16}$ and not more th ⅜ in. thickness of joint.

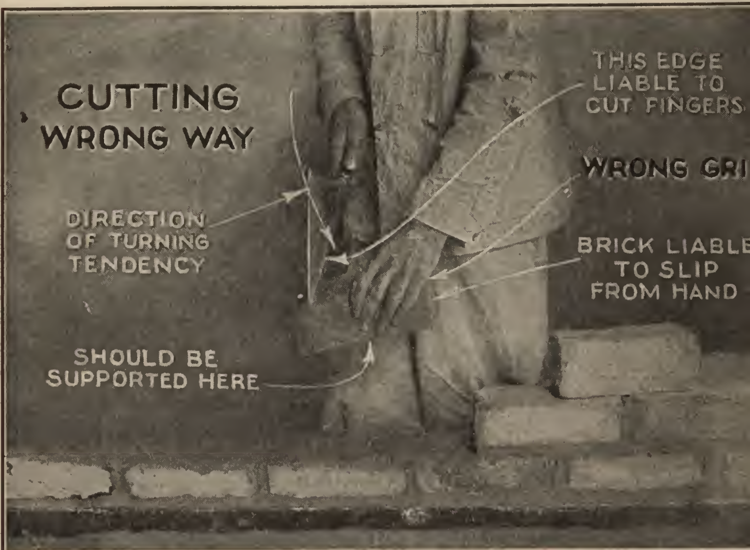


FIG. 4,013.—Cutting brick; trowel ***turned wrong*** way and hand holding brick wrong wa When held in this position the resistance of the air tends to turn trowel towards the ha with danger of cutting the finger. When the brick is held with hand in wrong positic there is no support on bottom of brick to resist the blow, hence blow is not so effective when brick is properly held.

A method sometimes used to allow for the thickness of the mortar joint is by the height of eight courses of brick measured in the wall.

This height should not exceed by more than the thickness of the brick the height of eight courses of the same brick laid dry. Since common brick are usually quite rough and uneven, it is not always easy to determine the thickness of a single joint, but the variations from the rule just given, in

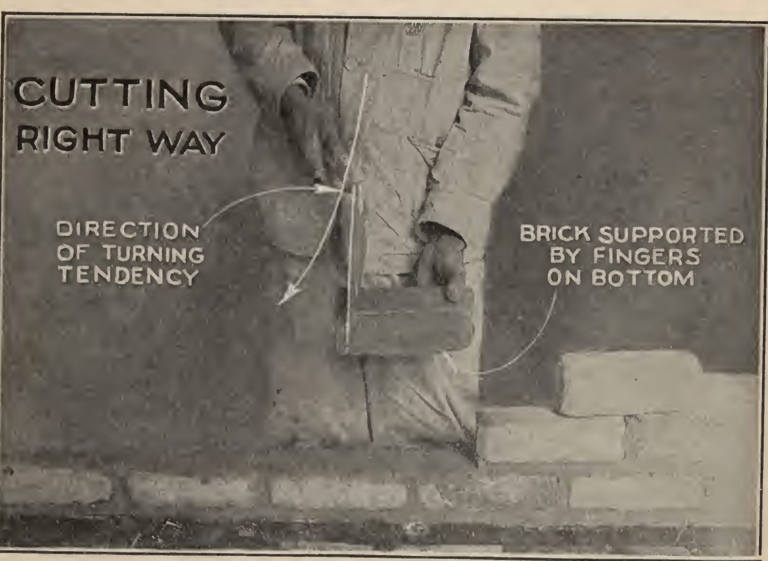


FIG. 4,014.—Cutting brick—***right way.*** Note position of hand and trowel. When trowel is held in this position it will tend to turn away from the hand, hence no danger of cutting fingers Note position of fingers supporting bottom of brick.

any eight courses that may be selected, should be very slight. The rule is illustrated in fig. 4,015.

Pressed brick, being usually quite true and smooth, may be laid with a ⅛ in. joint, though a $\frac{3}{16}$ in. joint is probably stronger, as it permits the use of more mortar, thus filling the joints better.

In order to obtain a uniform thickness of joints, the corner and lead, which is erected a few courses in advance of the wall for line supports as previously described, is done so with precision by aid of the gauge rod as shown in fig. 4,017.

Jointing.—The general appearance of a brick wall depends not only on the bond, but also on the form of jointing or facing given the mortar joints. Jointing may be classed:

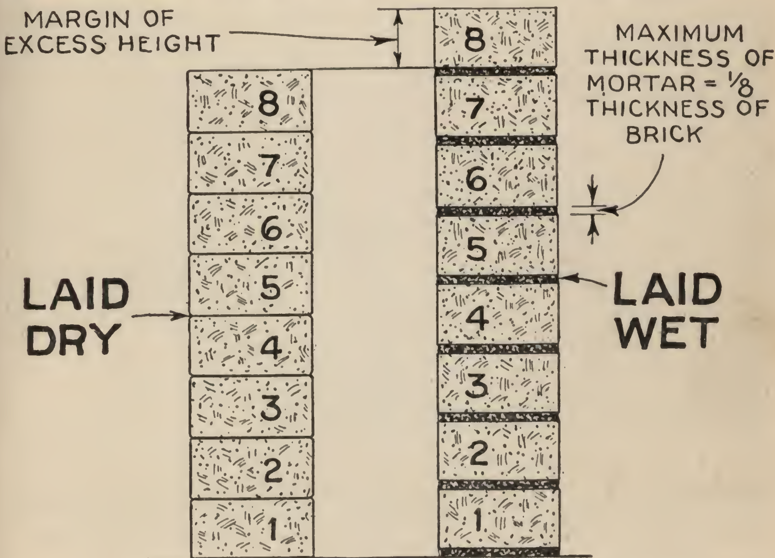


Fig. 4,015.—Eight courses of brick laid "dry" and "wet," illustrating ***Rule***: *Thickness of mortar must be such that height of eight courses laid wet will not exceed height of eight courses laid dry by more than thickness of one brick.* The terms *dry* and *wet* mean without mortar and with mortar, respectively.

1. With respect to material, as:

   a. Natural.
   b. Artificial.

2. With respect to its form or shape, as:

a. Flat.
b. Concave.
c. Convex.
d. V shape, etc.

3. With respect to the tool used, as:

a. Stick, or trowel.
b. Jointer, or tooled.

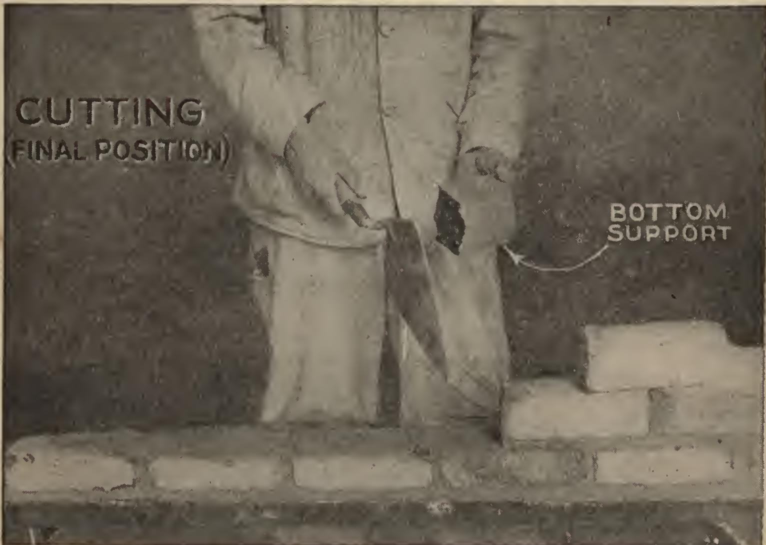


FIG. 4,016.—Position after cutting brick. Here position of finger on bottom of brick gives a firm hold. For rough brick, the cut, although somewhat ragged, is considered a good cut.

Jointing is employed for two reasons: 1, to make the joint waterproof, and 2, to secure ornamental effects. Sometimes one result is obtained at the expense of the other. Again the time required for jointing is sometimes considered in the choice.

Flat Joints.—The various joints coming under this head are

called *struck joints** because they are made by a stroke of the trowel. The simplest form is the *flush joint* shown in fig. 4,018. In this the mortar has been cut off with the trowel and

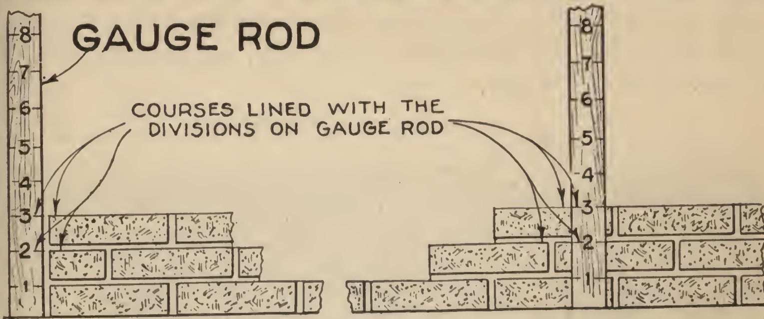


FIG. 4,017—Application of gauge rod in the erection of corner and lead supports for line. In this work each brick is carefully pressed down or tapped until its top is in line with the corresponding division on the gauge rod The thickness of joints for corner and lead is thus made uniform, and by aid of the line adjusted for these reference supports, the thickness is maintained uniform in building up the courses between the line supports.

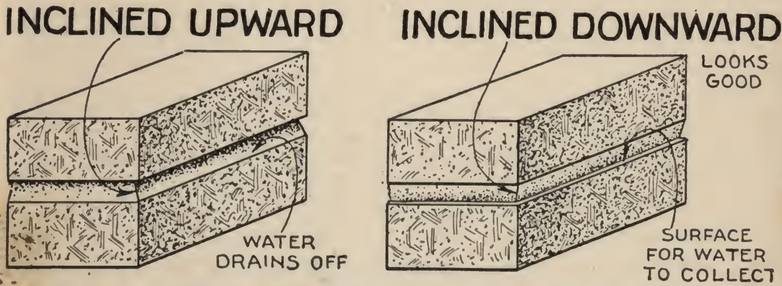
FIG. 4,018.—Bricklayer striking a flush joint.

*NOTE—***The misuse** of the term *struck joint* in restricting it to denote the joint formed by using the upper brick as a guide, and drawing the point of the trowel along the upper surface of the brick below, should be avoided by the better informed. Such definition is erroneous and ridiculous as any joint formed by a stroke of the trowel is a struck joint.

left without any further attention. Sometimes this is employed to give a rustic effect, and again to save time in the less conspicuous and unexposed portions of the brickwork.

Two other kinds of struck joint are the flat inclined joints with the inclination looking up or down as respectively shown in figs. 4,019 and 4,020.

The first known as weather joint is designed to shed the water and is therefore an efficient joint. The important objection to the weather joint



FIGS. 4,019 and 4,020 —Struck joints. Fig. 4,019, flat upward inclined or weather joint; fig. 4,020, flat downward inclined or so called *struck joint*.

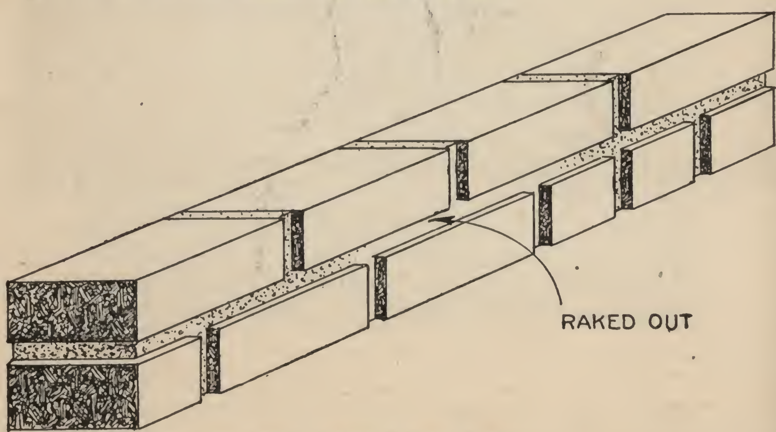


FIG. 4,021.—Raked or recess joint.

is that the top or true edge of the brick is concealed while the bottom or irregular edge is emphasized.

Jointer or Tooled Joints.—As distinguished from the trowel joints just described, those formed with a jointing tool are ordinarily called tooled joints. Evidently a great variety of such joints may be produced depending upon the form given the working ends of the tool.

FIG. 4,022.—Method of using a set. The beveled edge on set should be held toward the side being cut off.

A flat form of tool joint known as the *raked* or *recess* joint, as shown in fig. 4,021, may be produced with a flat end jointer by "raking out" the mortar to a given depth, or by laying a strip of wood to fit the depth and thickness of the desired recess upon the top edge of the brick, these strips being removed when the mortar sets.

The method of making tooled joints with straight edge and jointer is shown in fig. 4,023.

Concave joints may be flush as in fig. 4,026, or recessed as in fig. 4,027.

The flush form is known ordinarily as a concave joint and the recessed form as a rodded joint (so called probably because the so called "rod" must be used instead of the point of the trowel in making it).

FIG. 4,023.—Method of making tooled joints. First, smooth and flush joint with trowel so as to remove any distinct line where the edge of the brick leaves off, then rub joint with jointer tool close to the top edge of the brick, using a straight edge for the horizontal joints as shown, to guide jointer. The vertical joints should be ruled even less deep than the horizontal joints and should be ruled before ruling the horizontal joints.

Evidently by reversing the shape of the tool, a *convex joint* may be produced as in fig. 4,029.

Here the mortar projects outside the brick surface as shown.

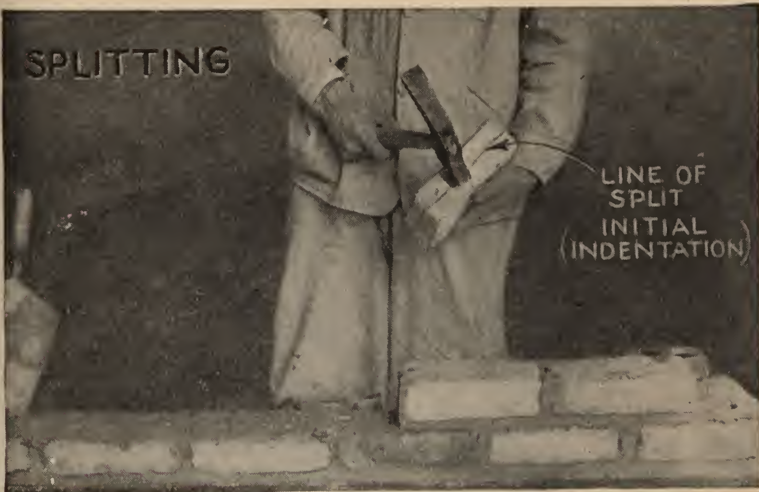
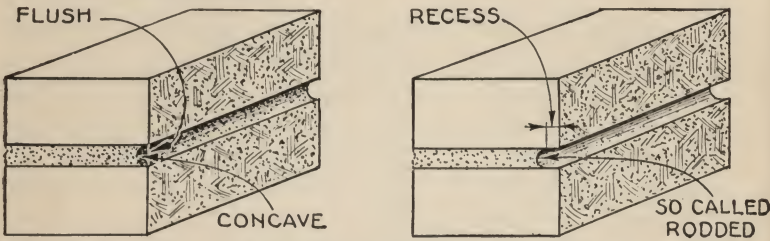


FIG. 4,024.—Splitting brick with head of hammer. The brick should be hammered lightly all around so as to secure a true split.

FIG. 4,025.—Appearance of brick after splitting. Showing the kind of split that can be expected.

The *V joint*, made with a V shape tool, is another form of tooled joint.

A joint made in this manner will appear smaller than it really is. Where the mortar is not noticeably different in color from the brick, this is probably the best way of hiding the inaccuracies of thickness of the different brick in the same course.



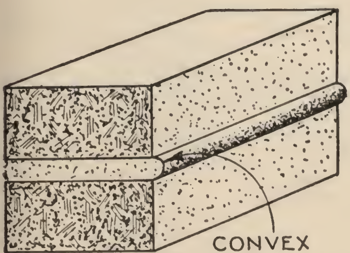
FIGS. 4,026 and 4,027.—Two forms of concave joint. ***The term flush*** as here used means that the arc of concave surface cuts the outside edges of the brick, whereas when *recessed* it cuts the bricks on their top and bottom faces, as shown.

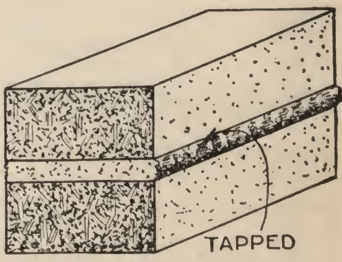
FIG. 4,028.—Trimming with pean of hammer. Should be done with short sharp blows.

The *tapped joint* shown in fig. 4,029 is so called because it is produced by giving the brick a tap with the trowel after the mortar has been cut off.

This style of joint is used with coarse sand where certain textures of wall surface are required.

Artificial Joints; Pointing.—The term pointing (as defined) means inserting mortar into the joints after the brickwork is completed in order to correct defects left during the progress of the work. In doing this, the mortar is raked out of the





FIGS. 4,029 and 4,030.—Two forms of projecting joint. Fig. 4,029, convex; fig. 4,030, tapped joint. This latter joint is virtually a bastard method of making a convex joint.

joints and the latter refilled and jointed with specially prepared mortar.

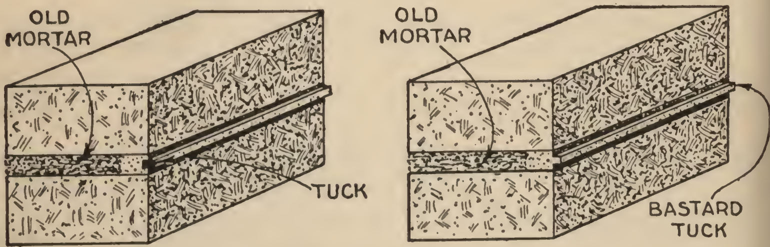
On old work the decayed mortar is raked out of the joint to a depth of at least ¾ in. and the joint filled in with cement or some hard setting mortar. The joint is then finished by any of the jointing methods just described or may be finished by one of two methods of pointing known as:

1. Tuck.
2. Bastard tuck.

these being fancy forms adopted by bricklayers to increase the effect of forming sharply defined joints.

Tuck Pointing.—In this method the raked out joint is filled flush with a "stopping" of cement or some hard mortar. The joint in this condition appears very wide, owing to the edges of the brick being ragged, this being due to the frost or to the clumsy method in which the joints have been raked.

The whole front, joints included, is then colored with a compound of copperas and a pigment of the color required, or the front is rubbed with a piece of soft brick till the bricks and the joints are of one color. An in-



FIGS. 4,031 and 4,032.—Tuck and bastard tuck pointing.

dentation is made in the filled joint and lime putty is pressed on to the joint with a jointer worked on a beveled edge straight edge, and before the latter is removed, the edges are trimmed with a Frenchman; in this operation the Frenchman cuts the mortar and the turned up end drags off the superfluous putty, leaving a white joint ¼ in. in width and ¹⁄₁₆ in. in thickness on the face of the work.

Bastard Tuck Pointing.—This joint is filled in with specially prepared mortar, finished and made to project in the same material with a thick bladed jointer. In this joint the ragged edges are cut off with the Frenchman.

CHAPTER 69

Bond

In brickwork, the term *bond* means *the overlapping of the brick one upon the other*, either *along the length of the wall or through its thickness in order to tie the brick together, thus increasing the strength of the structure.*

It is true, mortar is used to cement the brick together into a monolithic whole, but the real bond is the overlapping of the brick which the mortar serves to maintain. In bonding, brick are shifted back and forth so that the vertical joints in two successive layers or "courses" do not come into line; in other words, the brick are laid so as to break joint, the whole forming a natural bond or structural unity giving strength to the wall.

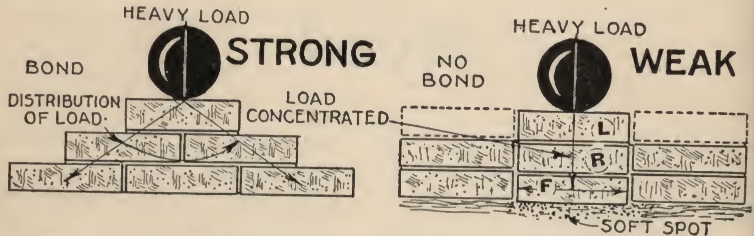
Lap.—The strength and rigidity of a wall due to bonding or overlapping of the brick as compared to a wall without bond is shown in figs. 4,033 and 4,034. Hence, in bonding the essential condition is that in any two successive layers or courses, *the brick of one course* ***must lap*** *over the brick of the other course.*

Fig. 4,035 illustrates the term *lap*.

The next consideration is naturally, how much must the brick lap? The important requirement as to amount of lap here given should be remembered.

No brick should ever be lapped less than ¼ of the brick length upon which it rests.

In practice the lap is made either ¼, ½ or ¾ of the brick length. Some means must evidently be provided to fill up the odd space which results when the courses are shifted to obtain lap. This is done:



FIGS. 4,033 and 4,034.—Strengthening effect of bond. In fig. 4,033, the bond or overlapping of the brick causes a load coming at any point to be distributed over several brick in the lower courses, thus avoiding the tendency to shear along two vertical joints as indicated in fig. 4,034. Here it could be imagined that a very heavy load is placed on brick F. Now suppose further that the two adjacent vertical joints were made with inferior mortar and poor workmanship; also that the foundation was first class except for a soft spot under brick F. Clearly the tendency would be to push down the three brick L, R, F, shearing along the vertical mortar joints. Comparing this with fig. 4,033, it is seen how the lapping of the brick prevents the action just described.

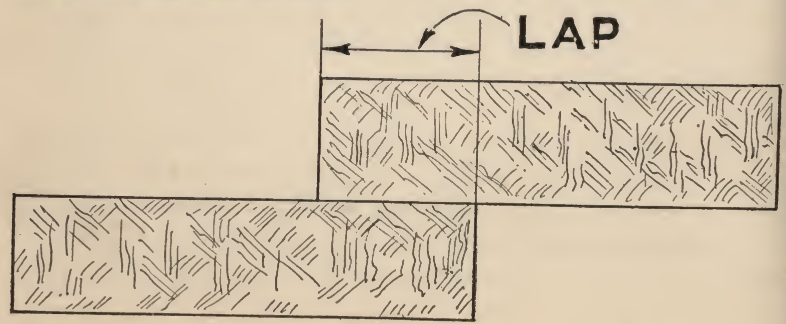
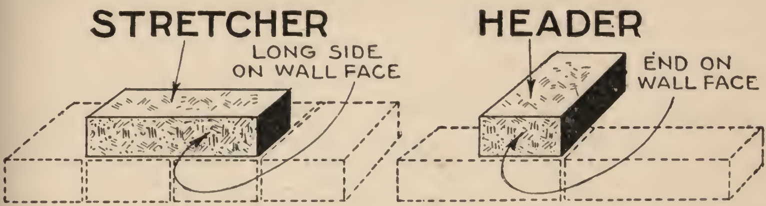


FIG. 4,035.—Two bricks of consecutive courses, illustrating *lap*.

1. By changing relative position of brick in alternate courses.
2. By inserting special size brick.

In speaking of brick bond, two terms are constantly recurring, viz., "stretcher" and "header." When a brick is laid lengthwise of the wall, thus showing its long narrow dimension or "face" on the surface, it is called a stretcher. If its length extend back into the wall, so that its short dimension shows on the surface, it is called a header. The stretcher secures



FIGS. 4,036 and 4,037.—Distinction between *stretcher* and *header*. As clearly shown, the terms relate to the position of the brick when laid and not to its size, that is, the same brick may be either a stretcher or header according to its position with respect to the face of the wall when laid.

strength in the length of the wall, and the header, strength across the wall.

Figs. 4,036 and 4,037 show the difference between a stretcher and a header.

The natural lap is **½ lap.**

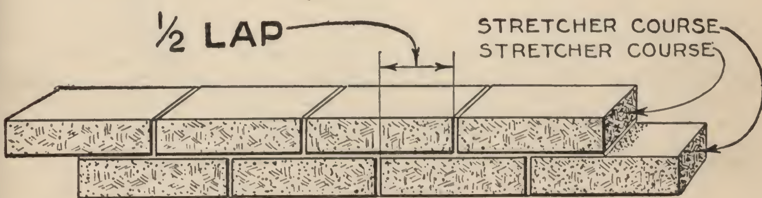


FIG. 4,038.—Two stretcher courses illustrating the *natural* or ***½ lap.***

This may be obtained, using simply stretchers and shifting the courses as in fig. 4,038.

The minimum lap is **¼ lap.**

There are two ways in which this lap may be obtained:

1. By headers only.
2. By stretchers and headers.

The first method as clearly seen in fig. 4,039 is similar to the method of obtaining ½ lap except that headers are used in place of stretchers. By the combination of alternate courses, stretchers and headers the same spacing is obtained as shown in fig. 4,040.

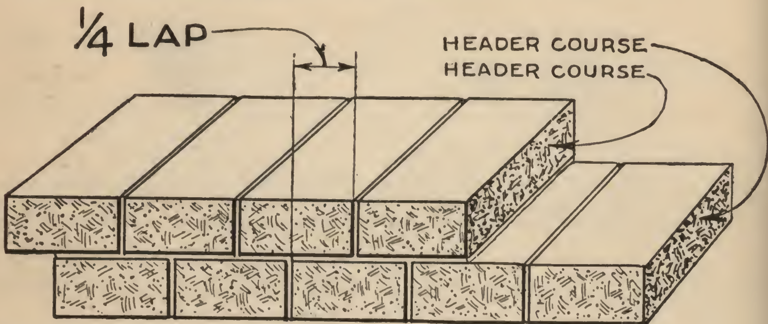


FIG. 4,039.—Two header courses illustrating the *minimum* or ¼ *lap.*

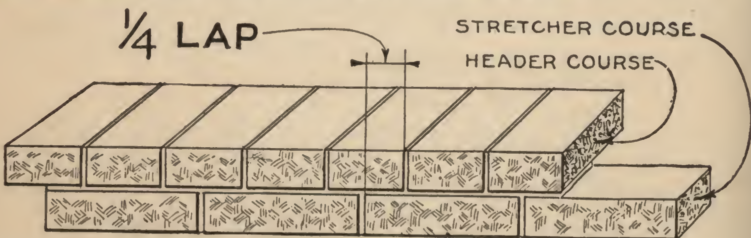


FIG. 4,040.—Alternate stretcher and header courses, illustrating ¼ *lap.*

The same spacing may be obtained by what is known as two stretcher combination courses, that is, courses composed of units of two stretchers and a header, the courses being shifted ¼ lap as shown in fig. 4,041. This is virtually a combination ¼ and ¾ lap.

The "on edge" lap is ⅓ ***lap.***

In a cheap method of constructing hollow walls, a combination of stretchers and headers are used in each course laid *on*

edge. The courses are shifted so that a header in one course will be centered with a stretcher in the next course as shown in fig. 4,042.

The maximum lap is ¾ ***lap.***

This may be obtained in several ways as:

1. By stretcher courses.
2. By two stretcher combination courses.

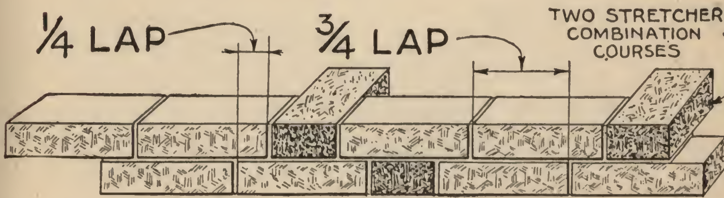


FIG. 4,041.—Two stretcher combination courses illustrating ***combination ¼ and ¾ laps.***

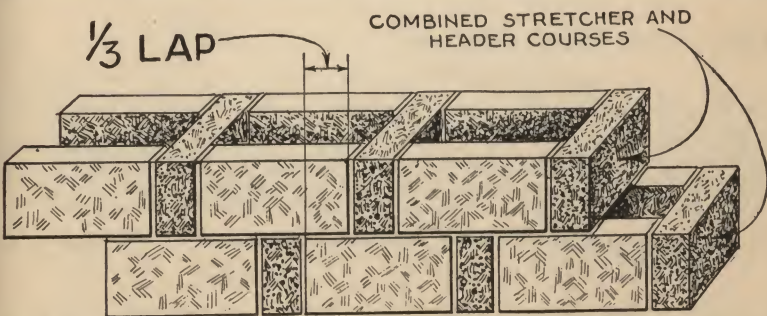


FIG. 4,042.—Ideal wall construction with combined stretcher and header courses, illustrating ⅓ ***lap.***

3. By three stretcher combination courses.

The first method gives the only true ¾ lap, the others giving combination ¼ and ¾ laps as shown in figs. 4,043 and 4,044.

Loss of Lap.—In laying brick, the bricklayer should be very

careful to maintain the lap as the work progresses course by course, that is, the vertical joint in each course throughout the height should be kept perpendicular, or directly over those in the second course below. This is called "*keeping the perpends*."

Unless close attention be paid to this, the lap will soon be lost due to irregularities in the length of the brick and thickness of the perpendicular joints, and the finished work will appear

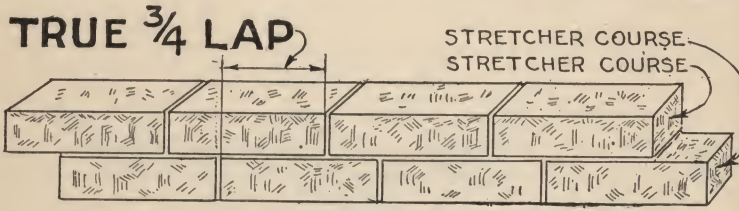


FIG. 4,043.—True ¾ *lap,* with stretcher courses only.

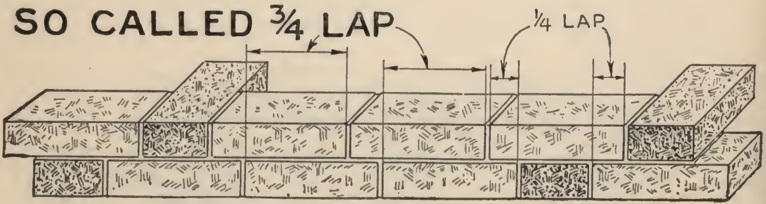


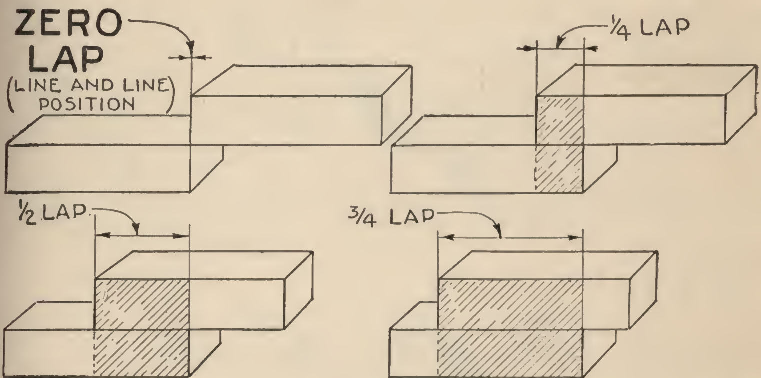
FIG. 4,044.—So called ¾ lap with three stretcher combination courses. ***This is virtually*** a combined ¾ and ¼ lap.

as in fig. 4,049 instead of as in fig. 4,050. It should be understood that brick vary in size, hence one reason for being careful to maintain the laps uniform.

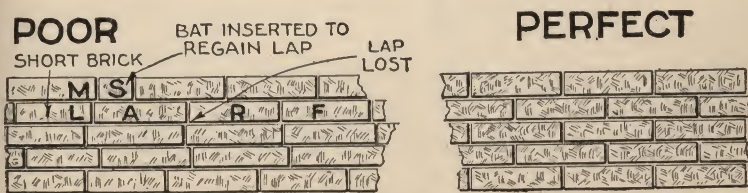
Nominal and Actual Lap.—Those who understand pipe fitting know that the sizes of wrought pipe as listed give no indication of the actual diameter of the pipe. Thus a pipe known as ¼ in. pipe is actually a trifle over ½ in. outside

diameter and approximate $^{23}/_{64}$ inside diameter (standard thickness)—the inside diameter varying according to the pressure for which the pipe is intended.

Evidently the arbitrary or nominal ¼ in. size is very convenient and avoids endless confusion.



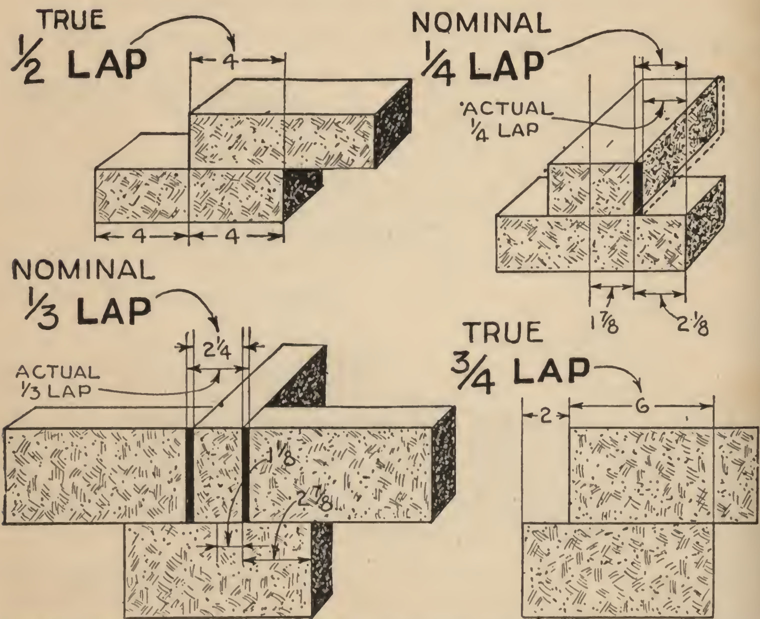
FIGS. 4,045 to 4,048.—Lap positions illustrating the term ***shifting*** of courses. In fig. 4,045 where the end of a brick of one course is *in line* with the end of the brick in the next course they are in *line and line* position and there is no lap. By moving or *shifting* the top brick ¼ its length to the left it will lap the brick in the next course by this amount and the bond is said to have ¼ *lap*, as shown in fig. 4,046. Similarly by moving it still further so that it covers the lower brick by ½ and ¾ of its length, the bond is said to have ½ and ¾ lap respectively, as shown in figs. 4,047 and 4,048.



FIGS. 4,049 and 4,050.—Appearance of bonding as executed by an amateur or greenhorn, and by a competent bricklayer. In fig. 4,049, due to short brick as L and A, the lap is lost, the course being continued as with bricks R, F, laid without lap. On the next course, in laying brick M, this is noticed and a bat S, inserted to regain the lap. Compare the appearance of this with the perfect job in fig. 4,050, remembering that not only the appearance but the strength of the wall is affected by losing the lap.

Similarly the size of brick vary both for different kinds of brick and brick of the same kind. Thus the new standard is $8 \times 2\frac{1}{4} \times 3\frac{3}{4}$ for common brick and $8 \times 2\frac{1}{4} \times 3\frac{7}{8}$ for smooth face brick. Similarly as with pipe, it is convenient in bricklaying to give nominal dimensions for the several laps, taken as fractional parts of the brick lengths, as ¼, ½ lap, etc.

In bonds made up of only stretcher courses evidently the true lap is



FIGS 4,051 to 4,054.—Nominal and actual lap for common brick. In the case of smooth face brick the dimensions given would change in some instances because a smooth brick is ⅛ in. longer than a common brick. In the above illustrations the brick are regarded as laid in contact with each other without any mortar intervening. This makes no difference, because in the case of mortar, one-half the thickness of the joint could be regarded as being part of one brick and the other half, part of the other brick; this, while changing the sizes of the brick would not change the relative proportions.

conveniently taken as in figs. 4,051 and 4,054, but where both stretchers and headers are used some arbitrary or nominal value for the lap is conveniently used to avoid confusion, as must be evident from figs. 4,052 and 4,053.

Special Brick for Bonding.—Since bonding requires various laps between courses (depending upon the kind of bond) evidently one or more brick of special sizes must be inserted in each course in order to make it come out right at the ends of the courses, or corners. These special brick then serve as *spacers* or fillers, filling up the space due to *shifting*.

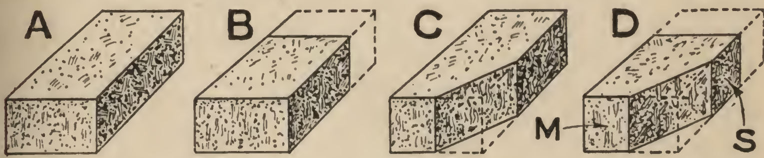
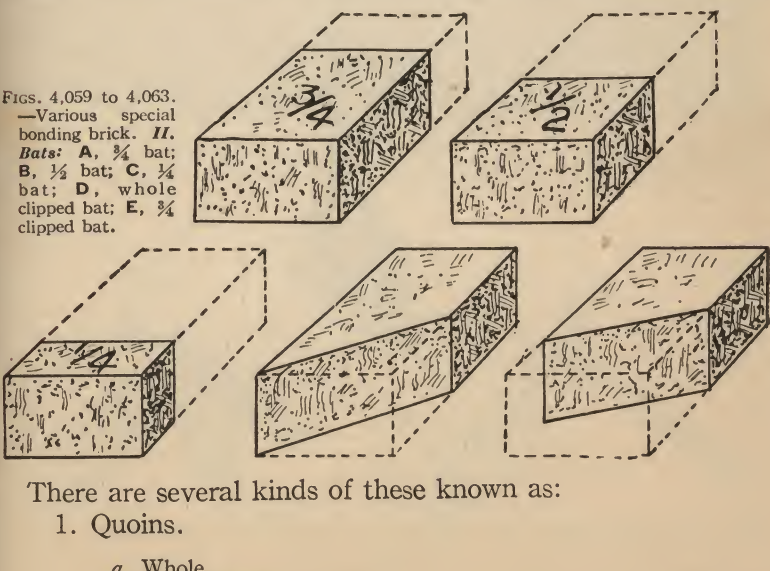


FIG. 4,055 to 4,058.—Various special bonding brick. *1, Quoins:* **A**, whole brick; **B**, ¾ bat; **C**, whole brick clipped; **D**, ¾ bat clipped. Note in clipping half the end and half the side (of the whole brick) are removed. In the ¾ clipped bat, M and S, are approximately the same size.

FIGS. 4,059 to 4,063.—Various special bonding brick. *II. Bats:* **A**, ¾ bat; **B**, ½ bat; **C**, ¼ bat; **D**, whole clipped bat; **E**, ¾ clipped bat.



There are several kinds of these known as:

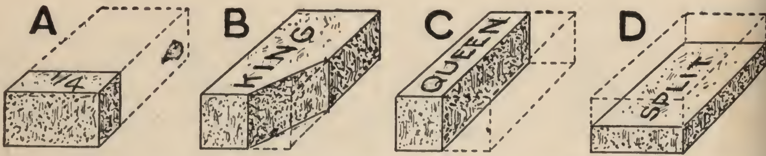
1. Quoins.

   a. Whole.
   b. Three-quarter.

c. Whole, clipped.
d. Three-quarter, clipped.

2. Bats.

a. Three-quarter.



FIGS. 4,064 to 4,067.—Various special bonding brick. ***III. Closers.*** **A**, ¼ bat or so-called "*closer*", **B**, clipped whole brick or *king*; **C**, long top split brick or *queen*; **D**, long side brick or *split*.

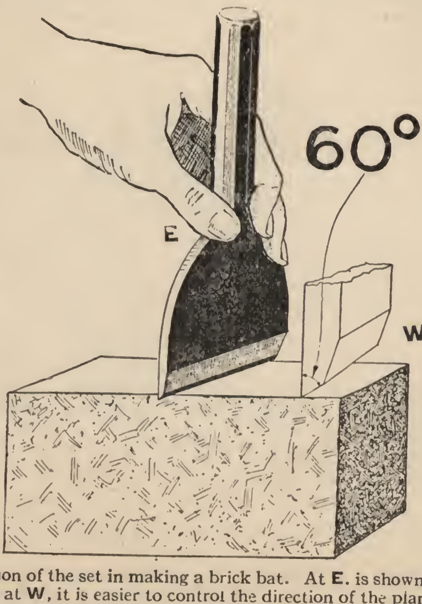


FIG. 4,068 —Application of the set in making a brick bat. At **E**. is shown an ordinary set. If the set be shaped as at **W**, it is easier to control the direction of the plane of fracture. If the bottom surface make 60° with the straight side as shown the plane of fracture will be about in the plane of the straight side.

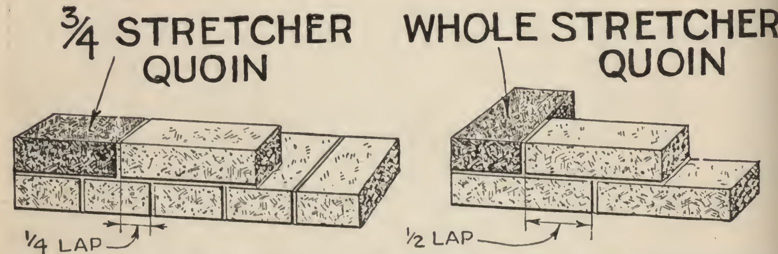
FIG. 4,069.—Bricklayer cutting a half bat with set and hammer. One sharp blow on the set should be sufficient to cause the brick to be broken by one or two sharp flat blows of the hammer on one of the bed surfaces of the brick in line where the line of fracture is desired.

FIGS. 4,070 and 4,071.—Use of the hammer in shaping brick. Fig. 4,070, head of hammer used in making a split; fig. 4,071, pean of the hammer used in chipping off lumps.

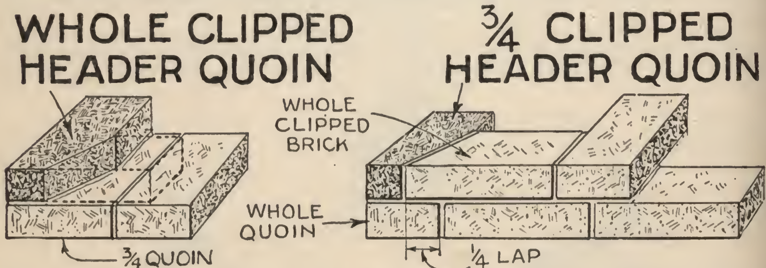
b. Half.
c. One-quarter.

3. Closers.

a. Closer (¼ bat).
b. King.
c. Queen.
d. Split



FIGS. 4,072 and 4,073.—***Use of quoins, 1.*** Fig. 4,072, ¾ (stretcher) quoin over header course to obtain ¼ lap; fig. 4,073, whole (header) quoin over stretcher course to obtain ½ lap.

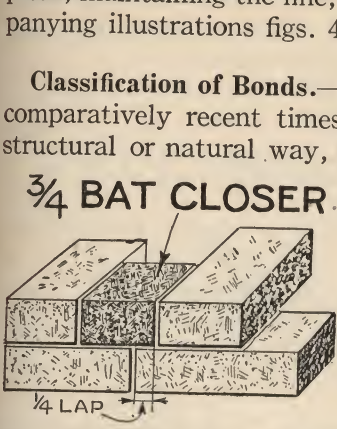


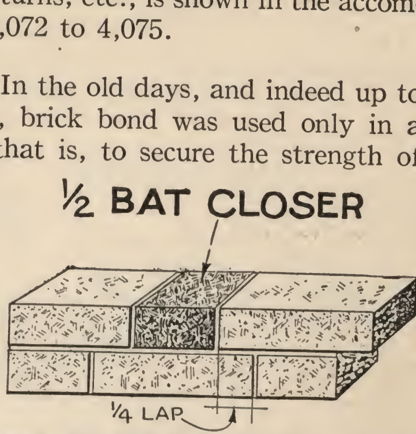
FIGS. 4,074 and 4,075.—***Use of quoins, 2.*** Fig. 4,074, whole clipped (header) quoin over ¾ (stretcher) quoin to obtain ¼ lap; fig. 4,075, ¾ clipped (header) quoin over whole (header) quoin to obtain ¼ lap.

These special forms are shown in figs. 4,055 to 4,063. The quoins and bats are made by cutting with a set as in fig. 4,068, queens and splits with the hammer as in figs. 4,070 and 4,071. The use of these various special bonding brick for obtaining

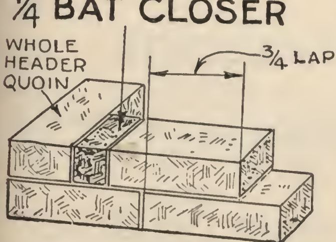
pitch, maintaining the line, turns, etc., is shown in the accompanying illustrations figs. 4,072 to 4,075.

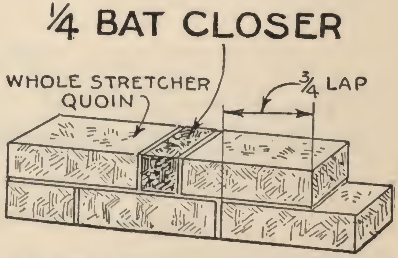
Classification of Bonds.—In the old days, and indeed up to comparatively recent times, brick bond was used only in a structural or natural way, that is, to secure the strength of





FIGS. 4,076 and 4,077.—*Use of bat closers, 1.* Fig. 4,076, ¾ bat (stretcher) closer over stretcher course to obtain ¼ lap; fig. 4,077, ½ bat closer over combined header and stretcher course to obtain ¼ lap.



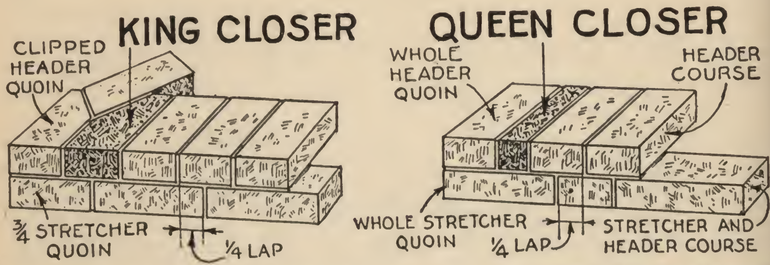


FIGS. 4,078 and 4,079.—*Use of bat closers, 2.* Fig. 4,078, ¼ (header) bat closer over stretcher course to obtain ¾ lap; fig. 4,079, ¼ (header) bat closer over stretcher course with (header quoin to obtain ¾ lap.

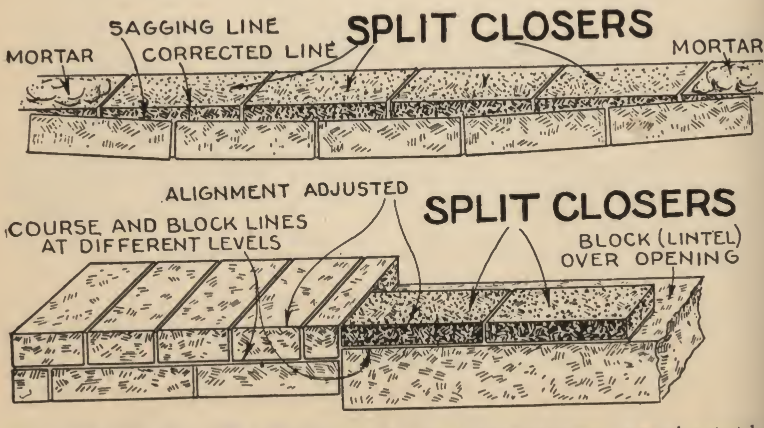
the wall as a solid mass; but in the seventeenth century European builders began to see an artistic possibility in the bond as it appeared on the surface. They began to see the fine tracery of the mortar joint running over the background of the brick, which could be varied into attractive patterns by different arrangement of the brick bond. As a consequence,

there have been developed three basic or fundamental bonds: 1, running; 2, English; 3, Flemish, with a multiplicity of modifications of each and some combinations.

Given in classified form, they are:



FIGS. 4,080 and 4,081.—*Use of king and queen closers.* Fig. 4,080, ***king closer*** following ¾ stretcher quoin over stretcher course giving acute angle corner in wall. The acute angle θ is approximately 30° depending upon the dimensions of the brick. Fig. 4,081, queen closer following whole stretcher quoin over combined stretcher and header course.



FIGS. 4,082 and 4,083.—*Use of split closers, 2.* Fig. 4,082, split closers, on sagging stretcher course to level up the line. This sagging may be due to uneven mortar joints, irregular brick or both; fig. 4,083, split closers over window or other opening cap showing how broken line is corrected.

1. Running or stretcher.

    a. Plain.
    b. Common or American
    c. Clipped.

2. Header.

3. English.

    a. Plain.
    b. Cross or Dutch.

4. Flemish.

    a. Single.
    b. Double.

5. Garden Wall.

    a. Two stretcher (Sussex).
    b. Three stretcher.
    c. Four stretcher.

6. Hollow wall.

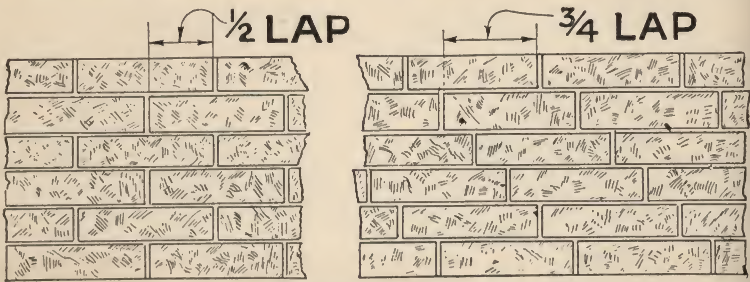
    a. Flemish.
    b. Clipped.
    c. Buck withe.
    d. Edge or Ideal all-rolok.
    e. Combined edge and side or, Ideal rolok-bak.

7. Raking.

    a. Diagonal.
    b. Herringbone.

8. Hoop iron bond.

Running or Stretcher Bond.—In the plain form of this bond the wall surface is made up of stretcher courses shifted for half or three-quarter lap as shown in figs. 4,084 and 4,085. It has the merit of being very strong longitudinally but weak transversely, and accordingly is modified into what is called



FIGS. 4,084 and 4,085.—Plain form of running or stretcher bond. Fig. 4,084, ½ lap shift; fig. 4,085, ¾ lap shift. Half lap gives the strongest longitudinal tie. The ¾ lap shown in fig. 4,085 is virtually ¼ lap as regards strength, because "a chain is no stronger than its weakest link," hence ¾ lap should only be used for ornamental effect.

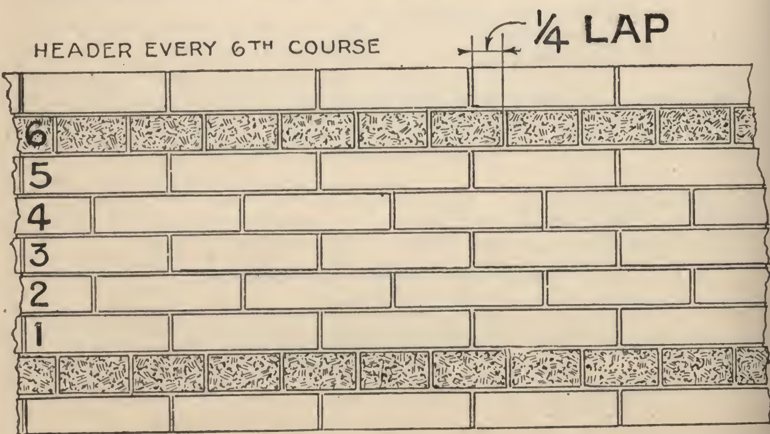


FIG. 4,086.—Common or American form of running or stretcher bond. This is the same as the plain form with exception of transverse bonding with a header course about every six courses.

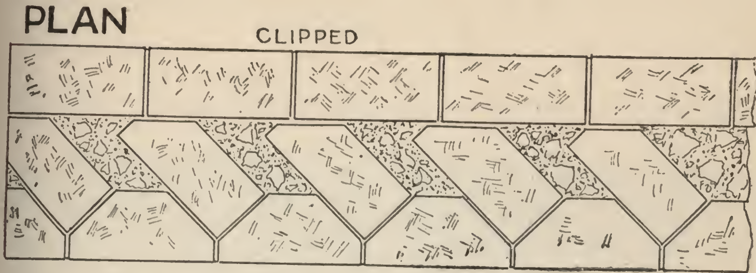


FIG. 4,087.—Diagonal form of raking bond. A view looking down on top the wall showing its thickness (plan) is here necessary to show the bond as the bonding is internal. The side of the wall is plain stretcher bond appearing as shown in fig. 4,084.

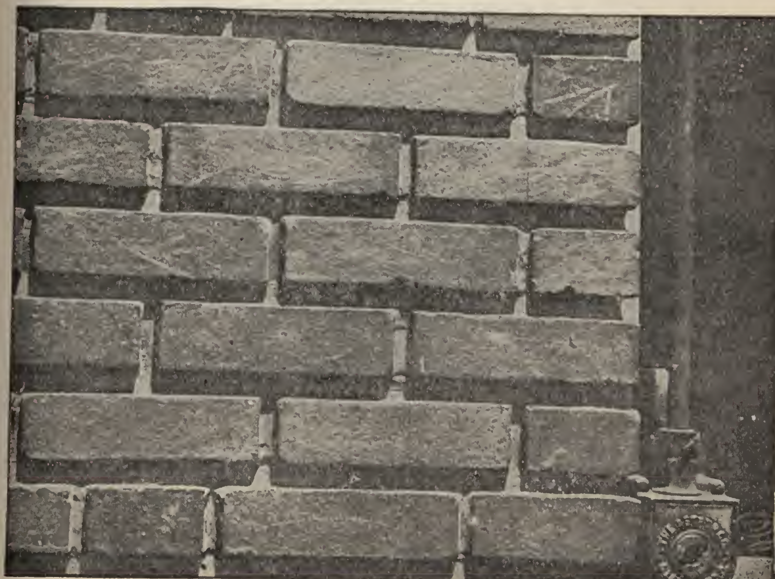


FIG. 4,088.—Appearance of wide stripped joint running or stretcher bond. The stripped joint is the neatest and cleanest raked joint and is especially useful with rough textured brick as it keeps the mortar from the face of the wall.

common or American bond by laying a course of headers about every sixth course as in fig. 4,086.

In a solid wall twelve or more inches thick, sometimes the brick in the center are laid diagonally every few courses, the triangular portion of the

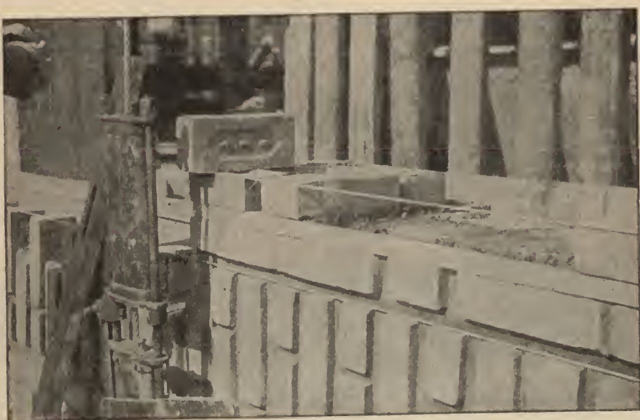


FIG. 4,089.—Method of forming stripped joint. Horizontal course in double Flemish bond; note flush joint between pairs of stretchers. ***In forming,*** a wood strip the thickness of the mortar joint is laid at the front of the wall, set in any depth desired. The bed of mortar is placed behind and flush with the top of the strip and the next course laid, the strip being removed when the mortar has set sufficiently.

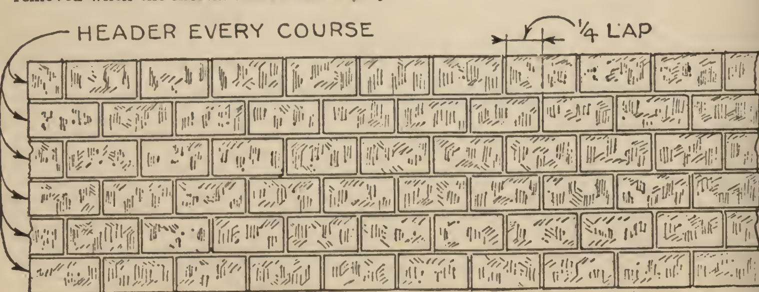


FIG. 4,090.—Header bond. This bond gives the minimum or ¼ lap which bonds longitudinally. Compared with other bonds in walls of same thickness it has the equivalent of transverse bond in the solid brick which extends the entire thickness of an 8-in. wall.

brick projecting beyond the backing, forming a tie sufficient only to attach the face brick to the backing. This is shown in plan in fig. 4,087 and forms a *raking bond*.

Header Bond.—Some authorities do not consider this strictly as a bond; this view is erroneous as longitudinally the

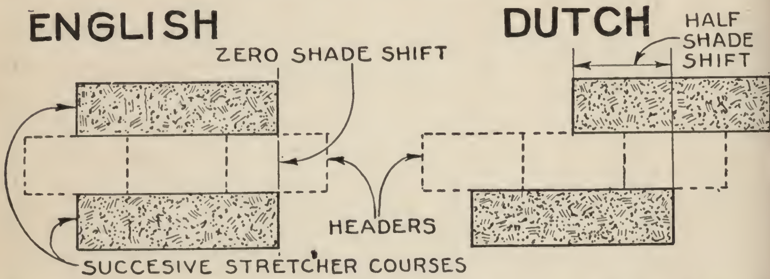
FIG. 4,091.—Appearance of struck joint common or stretcher bond. The mortar joint constitutes a considerable proportion of the area of the finished wall and hence should be considered as to its width, color, texture and section. With a standard brick, two headers require a ½ in. joint to coincide with the length of a stretcher. In forming bonds and patterns the ½ in. joint is thus most practical. Joints ⅝ and ¾ in. wide are used extensively and are very effective, the difference between the unit length of a stretcher and two headers plus a joint being taken up by slightly varying the width of the vertical joints. Joints 1 in. and even wider have been used. A joint of ¾ in. and over slows down the work, a thick bed of soft mortar under each brick being more difficult to manipulate. Special mortar should be used for wide joints.

brick are bonded by ¼ lap. It is used largely for ornamental effect and when so used it should be confined to panels or

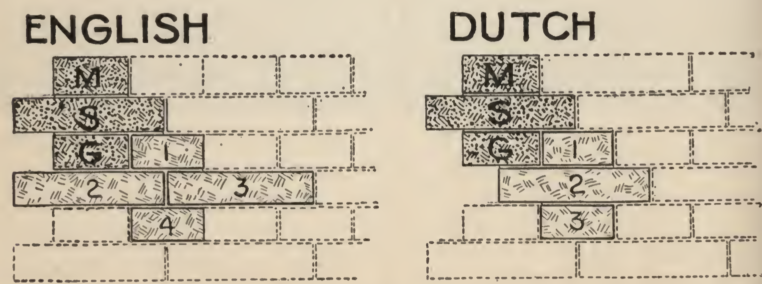
contained areas where a checkerboard effect is desired.

For curving walls, the curve can be more nearly realized with header bond than with stretcher bond, especially on short radius. The appearance of header bond is shown in fig. 4,090.

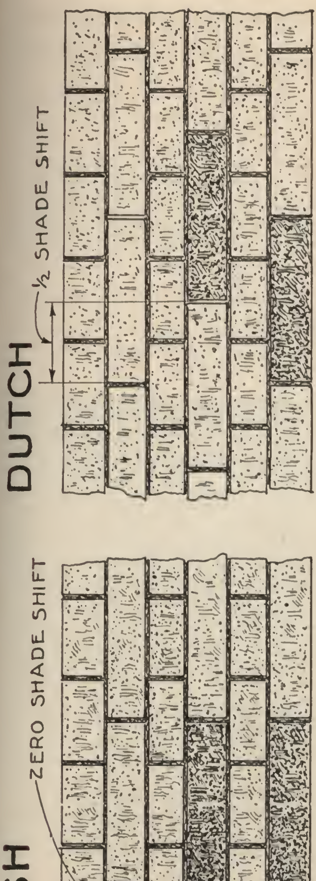
English Bonds.—The two bonds belonging to this class



Figs. 4,092 and 4,093.—Distinction between the two forms of English bond. It lies solely in the relative position of adjacent stretchers in successive stretcher courses. Fig. 4,092 shows the plain English bond in which the stretchers lie directly over each other or in 'line and line" position. ***To relieve the monotony*** of the resulting brickwork, the English bond has been modified as shown in fig. 4,093, by giving ½ *shade shift* to adjacent stretchers in successive courses producing, where brick of two shades are used (as will be shown later) a pleasing series of Greek crosses.



Figs. 4,094 and 4,095.—Comparison of the two English bonds showing error of calling the Dutch or modified English bond, by the name of *English Cross*. In the English bond there are alternately dissimilar crosses M, S, G and 1, 2, 3, 4, fig. 4,094, and in the Dutch bond similar crosses as M, S, G and 1, 2, 3, fig. 4,095; in other words, both bonds are cross bonds, the only difference is in the zero and ½ shifts given to the successive stretcher courses as previously explained.



FIGS. 4,096 and 4,097.—English and English cross or Dutch bond, showing zero and ½ shade shift of successive stretcher courses which distinguishes the two bonds.

consist of *alternate courses o stretchers and headers*, thes bonds being known as:

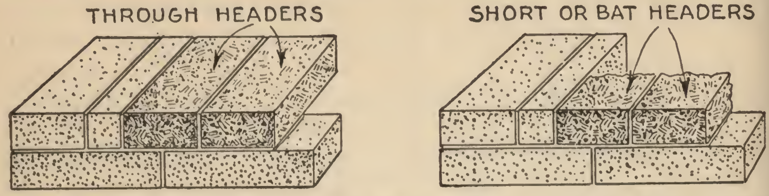
1. Plain English.
2. English cross, or Dutch

The distinction betwee the two types lies in th *amount of shade shift* given th successive stretcher course as shown in figs. 4,096 an 4,097. The modification i to relieve the monotony b producing a series of Gree crosses.

Fig. 4,096 and 4,097 show the appearance of the tw bonds.

The term "English cross" used for the Dutch modifica tion of English bond, i open to criticism for bot bonds are cross bonds, a shown in figs. 4,094 an 4,095, because both bond have crosses. The onl difference is that in th Dutch bond all crosses ar perfect, and whereas in th English every other cros (as cross 1, 2, 3, 4, fig. 4,094 is distorted.

Headers in Solid Walls.—The brick walls in an ordinary building are never called upon to support more than a small



FIGS. 4,098 and 4,099.—*Through* and *short* or *bat headers.* The number of through header courses is generally defined by building ordinances. Placing a header course at every sixth course (five non-header courses between) as in common American bond, is a safe rule, however, except where the backing brick are laid on a full bed of mortar but with dry vertical joints in which case through headers should be placed every fifth course.

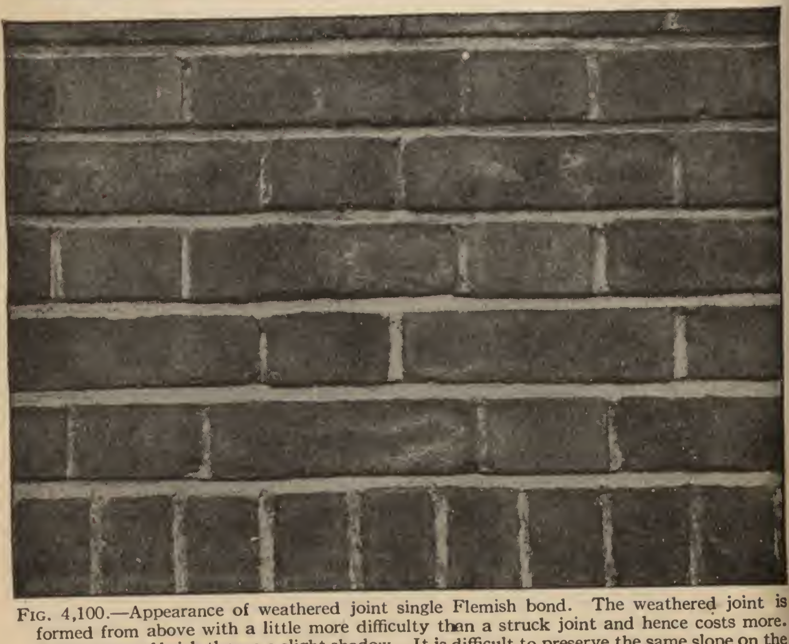
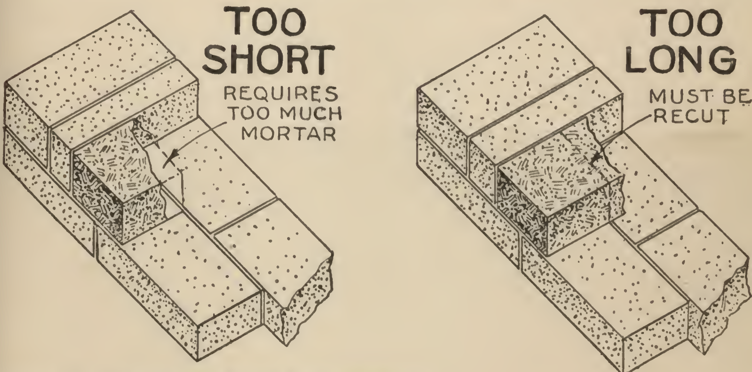


FIG. 4,100.—Appearance of weathered joint single Flemish bond. The weathered joint is formed from above with a little more difficulty than a struck joint and hence costs more. Each course of brick throws a slight shadow. It is difficult to preserve the same slope on the face of the joint.

part of the load they will safely bear. If the foundation settle unevenly, however, some stress may be caused in the direction of the length of the wall although the brick wall is adapted to adjust itself to slight movements such as this without cracking or other damage, by reason of its small units and numerous joints.

It would appear logical, therefore, to build a solid wall mostly of stretchers, with just enough headers to tie it together.



FIGS. 4,101 and 4,102.—*How not to cut bat headers.*

In a solid wall built entirely of common brick, all the headers which appear on the face of the wall are real or "through" headers. Where face brick are used, it is most economical to make all headers not required for ties, "bat headers," so that the face brick will go further. Face brick should be cut at the middle so that each half of the brick can be used for this purpose and waste avoided. Through and bat headers are shown in figs. 4,098 and 4,099 and how not to cut bat headers in figs. 4,101 and 4,102.

Flemish Bond.—This bond is easy to lay and is a favorite

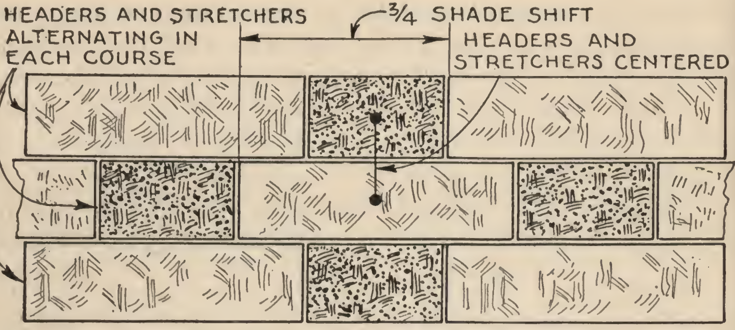


FIG. 4,103.—Conditions for single Flemish bond.

FIG. 4,104.—Appearance of flush joint Flemish bond. It is almost always finished with a rough texture. When used with rough texture brick it is difficult to keep the mortar from the face of the brick. Formed by cutting off mortar squeezed beyond the face of the wall. The joint

among builders for this reason and also because it produces artistic effects. Flemish bond consists of *headers and stretchers in each course with ¾ shift* which centers headers and stretchers in successive courses. These conditions are illustrated in fig. 4,103.

FIG. 4,105.—Appearance of concave joint Flemish bond, closers at corner. Concave and V joints are comparatively inexpensive to form and are weather resistive.

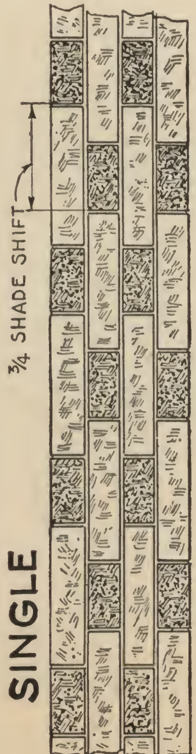
There are two varieties of Flemish bond:

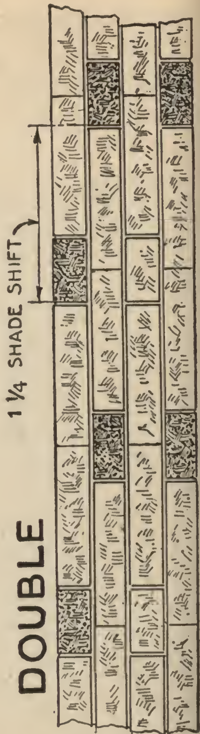
1. Single.
2. Double.

FIG. 4,104.—*Text continued.*

must not be manipulated afterwards with the trowel or the cement may be drawn to the surface and the rough texture spoiled. If further treatment be needed, the surface may be gently tapped with the end only of a piece of wood having an extremely rough end grain.

FIG. 4,106.—Conditions for double Flemish bond.



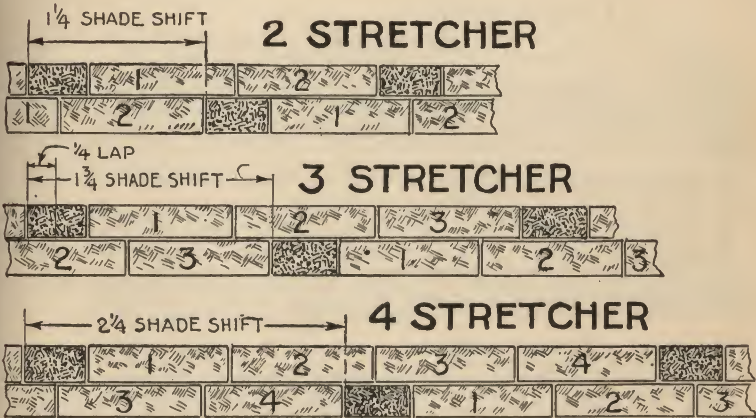


FIGS. 4,107 and 4,108.—Single and double Flemish bond. The blind or bastard joints are shown in dotted lines.

Single and double relates to the number of stretchers between successive headers in the same course. The conditions for single Flemish bond are as in fig. 4,103, and for the double form as in fig. 4,106.

Since in double Flemish bond the vertical joint between the two stretchers is always concealed or *blind*, these two stretchers appear as one long stretcher, and the arrangement may be regarded as a bastard form of the single or true Flemish bond. It is this blind joint that classes it as Flemish bond rather than garden wall bond.

The appearance of single and double Flemish bond is shown in figs. 4,107 and 4,108.



FIGS. 4,109 to 4,111.—Conditions for the various forms of garden wall bond. As the number of stretchers increase the shift required increases ½ for each stretcher. ***In all cases*** the lap is ¼. In the two and four stretcher bonds the header is centered over the joint between adjacent stretchers, and in the three stretcher bond, it is centered over the second stretcher. The stretchers are numbered to show this.

Garden Wall Bond.—This bond as its name indicates is used on garden or boundary walls where it is desired to keep fair face work on both sides of the wall. It consists of *combined stretcher and header courses with two or more stretchers between successive headers and no blind joints.*

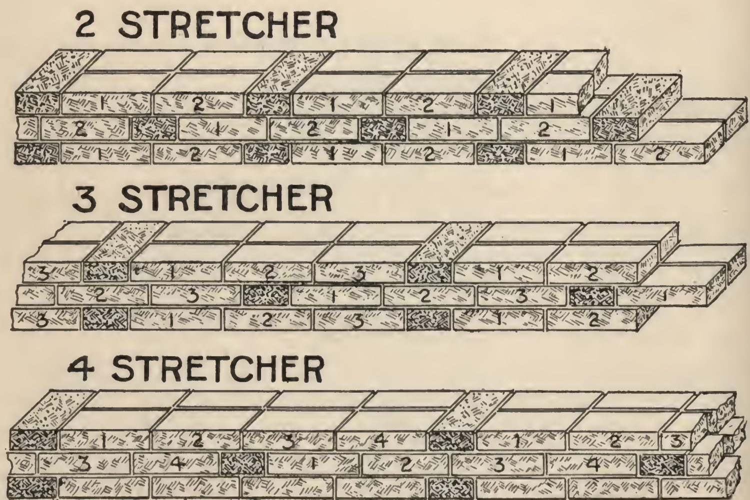
There are several varieties of garden wall bond, depending

upon the number of stretchers between successive headers, and called:

1. Two stretcher.
2. Three stretcher, etc.

There may be four or even five stretchers between headers.

The conditions for the various garden wall bonds are shown in figs. 4,109 to 4,111. The appearance of the various garden wall bonds are



FIGS. 4,112 to 4,114.—Various forms of Sussex, or garden wall bond.

shown in figs. 4,112 to 4,114. The value of these bonds lies in the longitudinal strength with sufficient transverse bonding.

From the point of view of transverse strength, the choice of the various garden wall bonds will be influenced by the height of the wall.

Hollow Wall Bonds.—With the ever increasing cost of material and labor any system of building that will reduce the

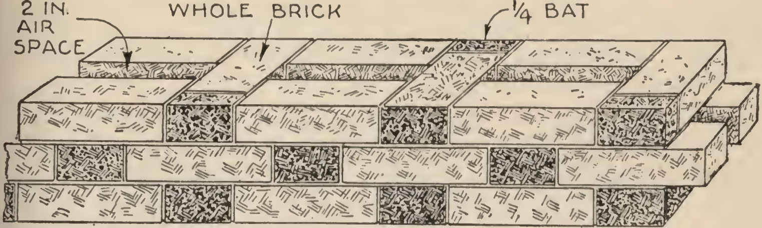


FIG. 4,115.—Hollow wall with single Flemish bond. Another construction would be to center the headers, filling the ends flush with mortar or leaving the spaces vacant, thus avoiding the cutting of bats.

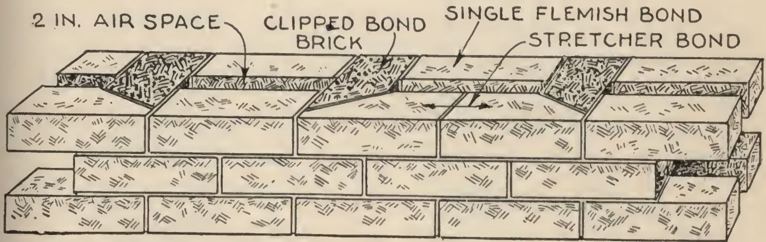


FIG. 4,116.—Hollow wall with chipped bond. The bond brick are cut at an angle as shown; they mitre into one side and form a header on the other side resulting in stretcher bond on the one side and single Flemish bond on the other side.

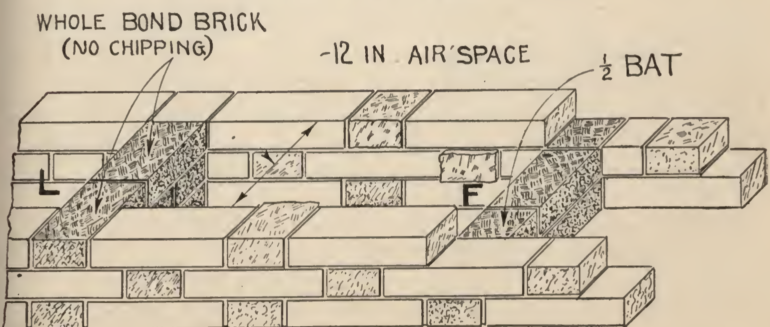


FIG. 4,117.—Hollow wall with brick withe bond. Evidently the air space may be varied to suit the height of the wall. ***The usual practice*** is to chip the bonding brick, but the design here shown is simpler and evidently can be executed with less labor and less waste. At **L**, two whole brick are used (no chipping), while at **F** it is only necessary to cut a half bat.

expense of construction should be considered. However, the modern tendency of too much "skimping" should not be tolerated.

FIG. 4,118.—Hollow wall with brick set on edge in single Flemish bond. A cheap yet strong wall.

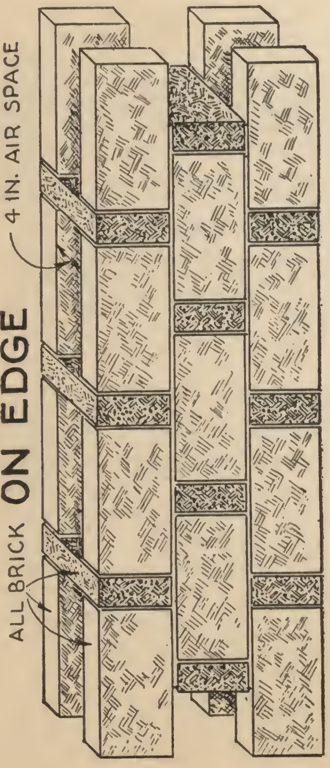


FIG. 4,119.—Hollow wall with brick set *combined edge and side* in running or stretcher bond, transversely bonded with headers every several courses. The headers are laid flat as shown and ventilation secured by omitting the mortar where they cross the air space. This makes a stronger transverse bonding than the arrangement shown in fig. 4,118, but the ventilation is not so good.

Thick hollow walls (16 in.) are very desirable. While the cost is more, the air space helps to keep out moisture and results in a cooler building in summer and warmer in winter. The air space should be continuous through-

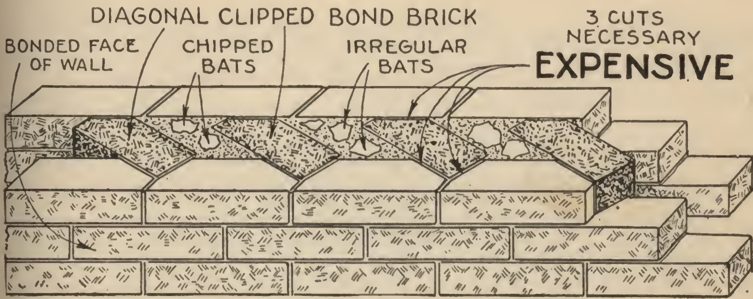


FIG. 4,120.—Diagonal form of raking bond ***holding one side in bond.*** Because of the amount of chipping that must be done, it is an expensive form of bonding. The small bats chipped off are used as fillers as shown.

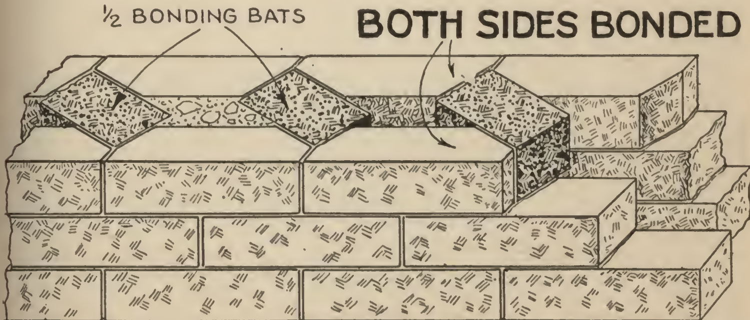


FIG. 4,121.—Diagonal form of raking bond ***holding two sides in bond*** with ½ bonding bats.

out the wall in order to obtain the full benefit of the space, and the connecting bond should be of such shape and material that any moisture penetrating the outer portion of the wall cannot penetrate the inner part. It is practically impossible where a wall has openings to provide a continuous air space, though it may be closely approximated. The

accompanying cuts, figs. 4,115 to 4,122, show the various methods of bonding hollow walls.

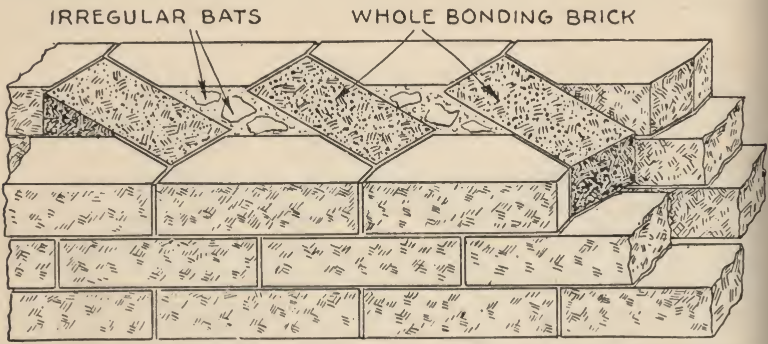


FIG. 4,122.—Diagonal form of raking bond *holding* ***two sides in bond*** with whole bonding brick.

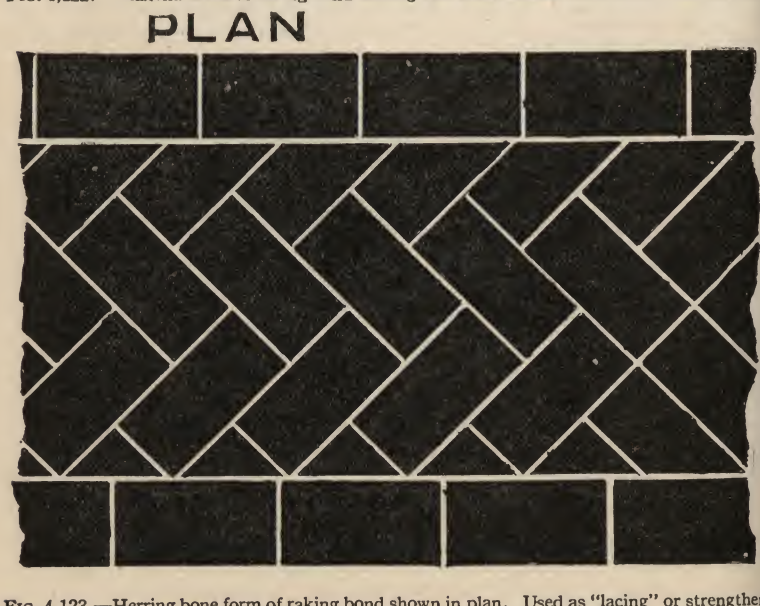


FIG. 4,123.—Herring bone form of raking bond shown in plan. Used as "lacing" or strengthening courses in thick walls and also for flooring and sidewalks.

Raking Bonds.—In bonds of this type *the bonding brick are laid at an angle other than* 0 *or* 90°, *usually* 45°. The two forms of raking bond are known as:

1. Diagonal.
2. Herringbone.

When pressed or façe brick are used for the exterior facing of a wall, it detracts from the appearance of the brickwork if bonding headers appear on the visible surface of the wall. One

FIG. 4,124.—Corner construction of Ideal all rolok wall showing 2¼ in. webs and ventilated air space.

FIG. 4,125.—Bricklayer laying hollow wall in single Flemish bond with brick on edge.

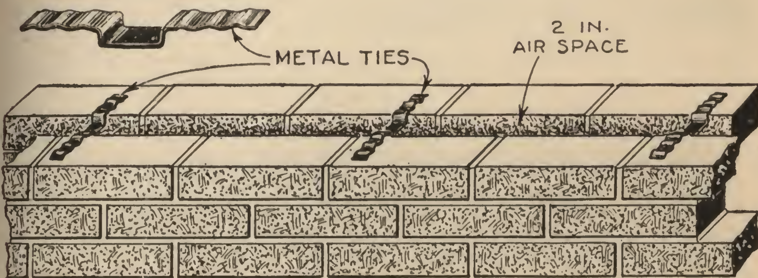
method of avoiding the difficulty is by using diagonal bond as shown in figs. 4,120 and 4,121.

Where walls are very thick the herringbone bond is sometimes employed for bonding the interior mass of the wall, as in fig. 4,123.

Metal Tie or Hoop Iron Bond.—A method of bonding which may be used on either

solid or hollow walls is by means of metal ties of which there is a great variety of shapes. Fig. 4,127 shows a metal tie shaped for a hollow wall and fig. 4,128 its application.

FIG. 4,126.—Bungalow built in 1880 at Arhultemala, Sweden, showing exterior appearance of Ideal wall.



FIGS. 4,127 and 4,128.—Metal tie of hoop iron shaped for hollow wall and its application to same.

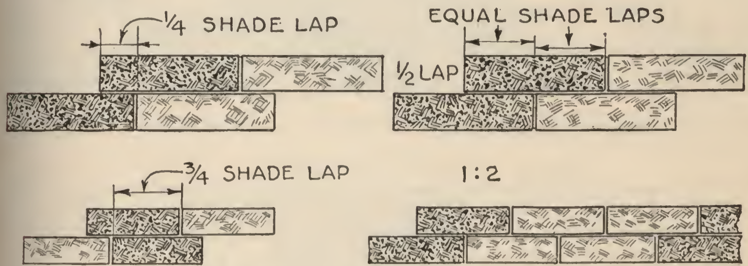
Sometimes for solid walls these ties are simply made out of wire. In using ties care should be taken that the ones used do not take up more space than the thickness of the mortar

joint, otherwise the brick would be thrown out of line and undue stress brought on same. Metal ties have been objected to because of their tendency to rust.

CHAPTER 70

Patterns in Brick Walls

A great variety of ornamental figures may be obtained by the use of light and dark brick or brick of various shades, and by the combination of headers and stretchers in each course variously arranged.



FIGS. 4,129 to 4,131.—Stretcher bond patterns with two alternate shades. Fig. 4,129, ¼ shade lap; fig. 4,130, equal shade lap; fig. 4,131, ¾ shade lap.

FIG. 4,132.—Stretcher bond pattern with one dark brick to two light brick.

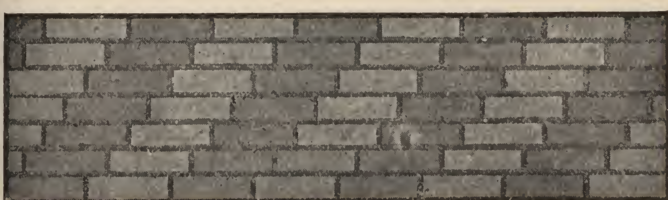


FIG. 4,133.—Appearance of wall laid with *stretcher bond*, two shade, ¾ *shade lap*. This pattern is rarely used for any large surface but frequently occurs in two or three courses separated by a Flemish or a header course, approaching in its nature the common bond. The author is indebted to the *Hydraulic-Press Brick Co.* for this and similar half-tone illustrations showing *appearance* of various bonds.

Stretcher Bond Patterns.—With alternate light and dark brick, various effects may be produced depending on: 1, lap; 2, shift; and 3, relative position of shades in adjacent courses as in figs. 4,129 to 4,131. The appearance of a wall laid according to fig. 4,129 is shown in fig. 4,133.

A variation consists of laying two light brick to one dark brick, thus further separating the dark diagonals as in fig.

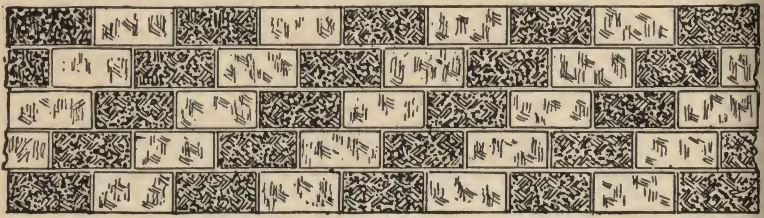
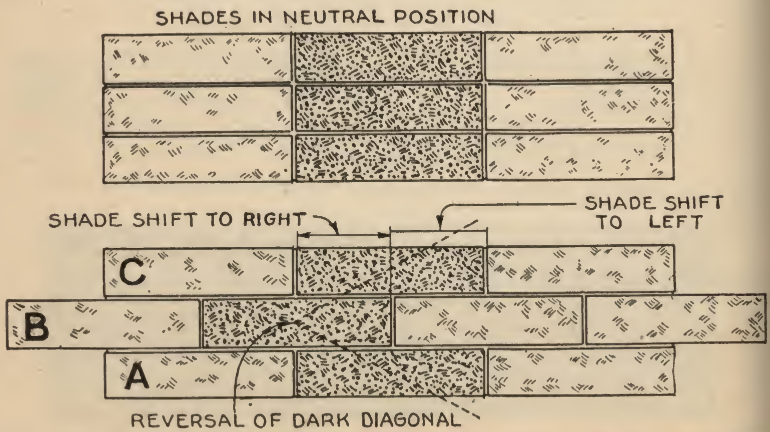


FIG. 4,134.—Appearance of wall laid with *header bond*, two shade, ¼ lap.

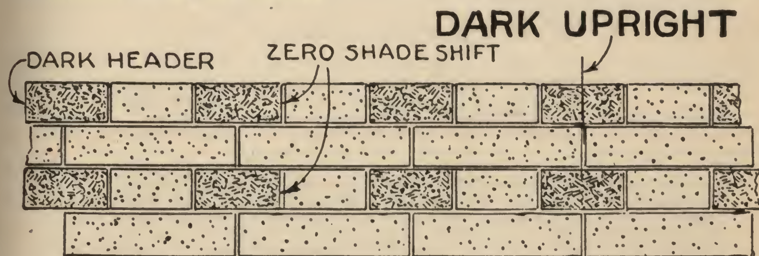


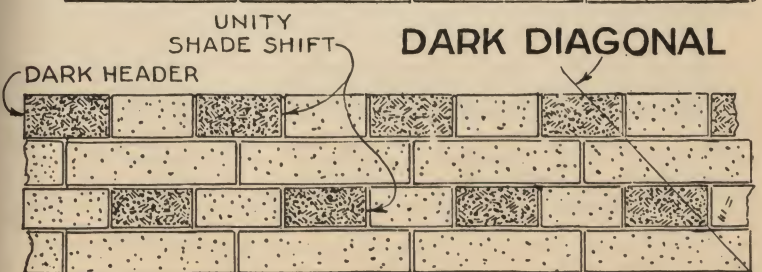
FIGS. 4,135 and 4,136.—Reversal of dark diagonal by reversing the shift. In fig. 4,135, three courses of brick are shown laid over each other with shades matched, that is shades in neutral or zero shade lap position. Evidently starting from course A, fig. 4,136, if the shift be reversed in laying courses B and C the dark diagonal will reverse as indicated by the dotted line, thus relieving the monotony of long diagonals.

4,132. Evidently various other combinations of the two shades may be made, securing additional effects.

Header Bond Patterns.—Evidently similar two shade effects may be obtained in header courses but only with ¼ lap. The general appearance of a wall laid with two shade headers alternating is indicated in fig. 4,137.

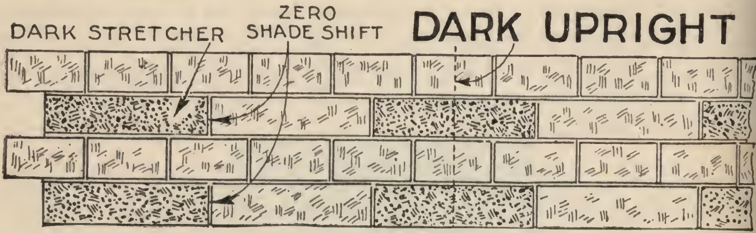
FIG. 4,137.—Appearance of wall laid in header bond two shade with reversal of shift breaking the monotony of long dark diagonals.

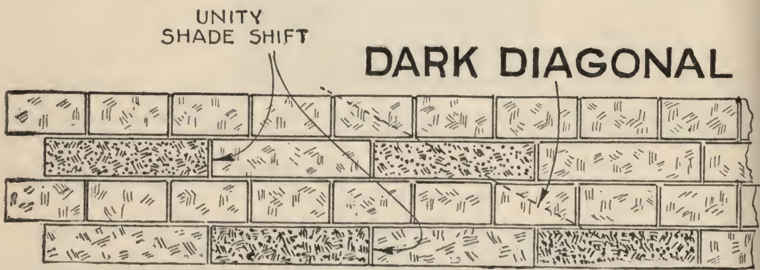




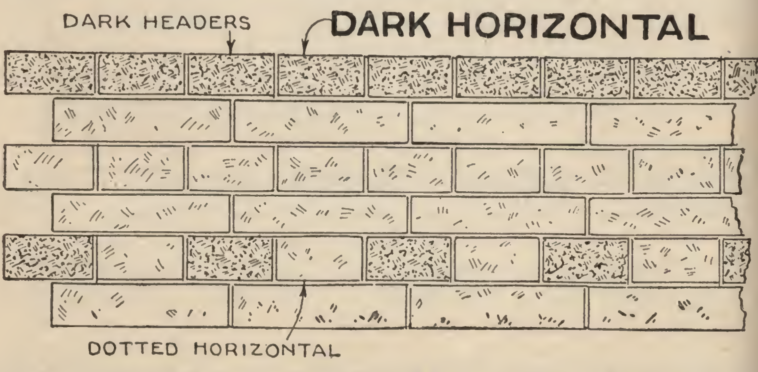
FIGS. 4,138 and 4,139.—English bond *with dark header*. Fig. 4,138, zero shade shift, dark upright; fig. 4,139, unity shade shift, dark diagonal.

Reversal of Shift.—The monotony of long "dark diagonals" may be broken by the simple device of reversing the shift as





FIGS. 4,140 and 4,141.—English bond with alternate *dark stretcher.* Fig. 4,140, zero shade shift, darkupright; fig. 4,141, unity shade shift, dark diagonal.



FIGS. 4,142.—Common or American bond with dark headers, showing dark and dotted horizontals.

indicated in figs. 4,135 and 4,136.

Fig. 4,135 shows three courses laid with shades in neutral position. By shifting alternately to right and left as in fig. 4,136 the dark diagonal is reversed. The appearance of a wall laid in header bond with reversal of shift is shown in fig. 4,137.

English Bond Patterns.—Various patterns may be obtained

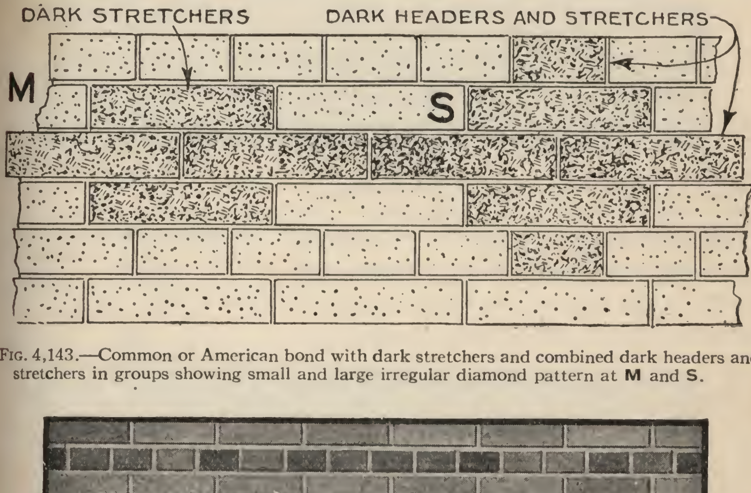


FIG. 4,143.—Common or American bond with dark stretchers and combined dark headers and stretchers in groups showing small and large irregular diamond pattern at **M** and **S**.

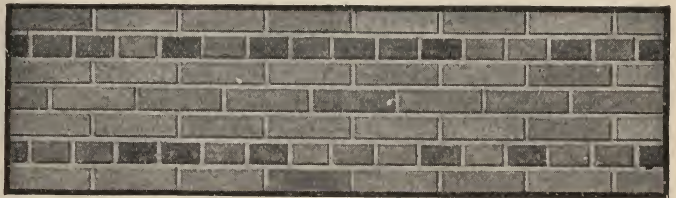


FIG. 4,144.—Appearance of common or American (3 stretcher) bond with some dark horizontals of several shades.

by the use of dark brick for: 1, headers; 2, stretchers; 3, both headers and stretchers in combination with various shade shifts, reversal of shifts, etc. These are shown in the accompanying illustrations figs. 4,144 to 4,146.

Common or American Bond Patterns.—Effects may be obtained in this combination of stretcher and header bonds in various ways. Thus dark horizontals at uniform intervals are obtained with dark headers, also "V's" and even diamonds by proper placing of dark brick as shown in figs. 4,144 to 4,146.

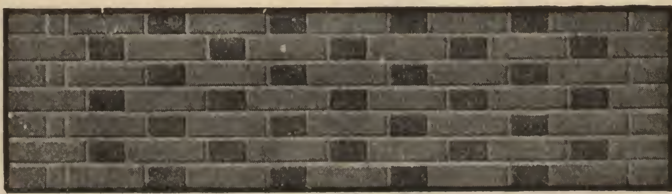


FIG. 4,145.—Appearance of single Flemish bond with drak headers, producing combined dark uprights and dark diagonals or checker board effect.

Flemish Bond Patterns.—A multiplicity of patterns are obtainable in Flemish bond (single and double) using, similarly as with the bonds just described, dark headers, dark stretchers or combination of both in groups.

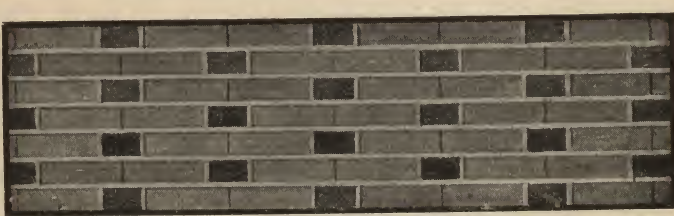
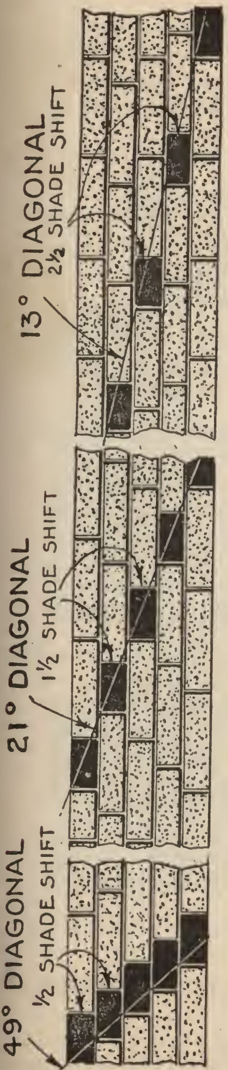


FIG. 4,146.—Appearance of double Flemish bond with dark headers producing combined dark uprights and dark diagonals, the uprights being more emphasized than with the single bond.

The Flemish bond with dark headers gives dark uprights and dark diagonals combined as shown in figs. 4,145 and 4,146, illustrating single and double forms of the bond.

The effect of varying the shade shift is shown in figs. 4,147 to 4,149. A dark diagonal obtained with dark stretchers laid ¾ shade shift is shown in fig. 4,150.

Garden Wall Bond Patterns.—Due to the increased number



FIGS. 4,147 to 4,149.—Effect of changing the shade shift in inclination of dark header diagonals in single Flemish bond.

of stretchers used in this bond the patterns obtained are more extended than in the other bonds. Fig. 4,151 shows appearance of the three stretcher form with dark headers, the latter centered over stretchers. A three shade effect, with garden wall courses alternating with stretcher courses, is shown in fig. 4,152.

Diamond Unit Patterns.—The accompanying illustrations figs. 4,153 to 4,161 show the unit system used by Gilbreth, the diamond shapes formed by various combinations of headers and stretchers, represent the various units or "eyes" upon which all diagonal bonds are based.

Beginning with unit I, which is composed of a stretcher with a header centered above and below it, each succeeding unit is formed by extending every course of the preceding unit the width of a header, always centering the courses on the middle course regarded as the horizontal axis of the unit, and terminating the whole above and below by a header.

As a result the units, however far they may be carried out, always present exact mathematical proportions and bear a definite relation to each other.

The serial number of any particular unit may at once be known by subtracting one from its number of courses and dividing by two; or, more simply, by counting the number of courses either above or below the

horizontal axis. Conversely, the number of courses in any given unit may be known by doubling its serial number and adding one. Thus, if we discovered in a brick wall a unit of nineteen courses, nine courses on either side of the horizontal axis, we should know that it was unit 9; or,

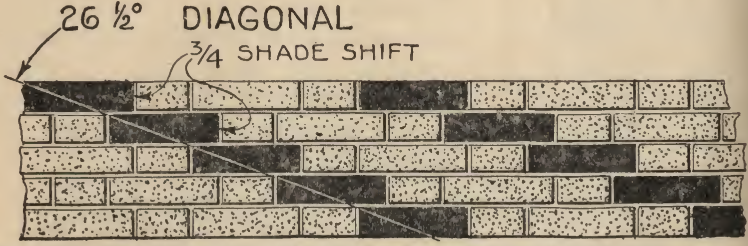


FIG. 4,150.—Dark stretcher diagonal in single Flemish bond with ¾ shade shift.

FIG. 4,151.—Appearance of three stretcher garden wall with dark headers, zero shade shift.

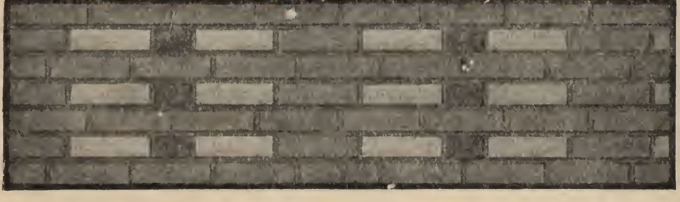


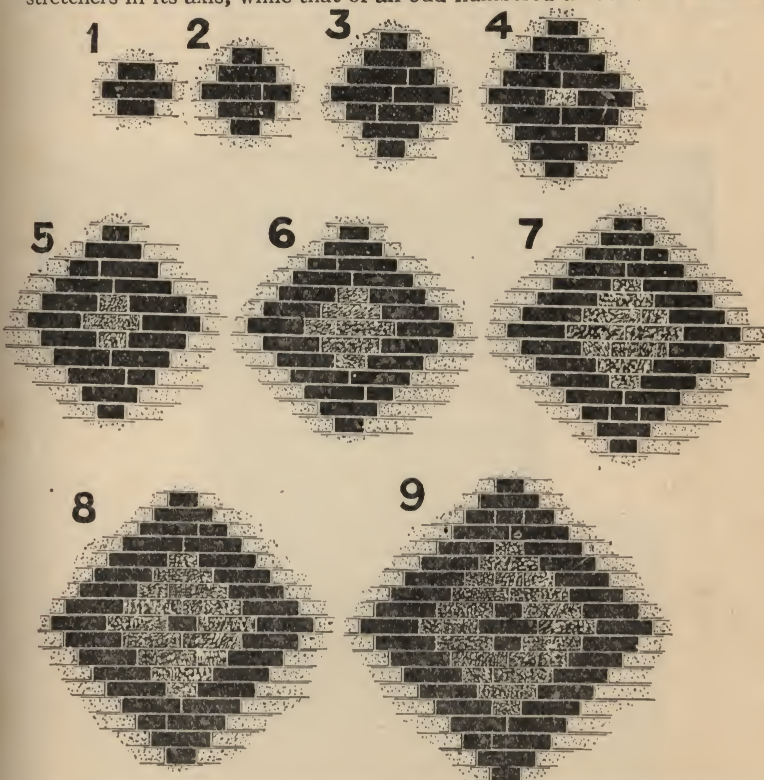
FIG. 4,152.—Appearance of combined three stretcher garden wall bond and stretcher bond (alternating courses) with three shades.

if we wished to use unit 9, we should always be obliged to have space for nineteen courses; and so on.

It is interesting to note further that the units may also be recognized by their horizontal axes, which in odd numbered units are always

composed entirely of stretchers, while in even numbered units they always carry one, and only one, header, set as near their center as possible.

The serial number of an even numbered unit is double the number of stretchers in its axis, while that of an odd numbered unit is one less than



FIGS. 4,153 to 4,161.—Diamond unit pattern or "eyes," showing diamond shapes ranging from 3 brick 3 course to 55 brick 19 course in size. Note first four are solid diamonds and **5** to **9** may be either solid or hollow as indicated by the emphasized joints.

double the number of its axial stretchers. Thus, if we see a unit with a horizontal axis of four stretchers only, we may be sure that it is odd numbered unit 7; but if it have four stretchers *and* a header, we know that it is the even-numbered unit 8.

With unit 4 there begin to appear units within units. While the header, crossed by vertical stretcher joints, which appears at the center of unit 4 is not strictly a unit in our sense of the term, it is nevertheless the primary unit of all, as the smallest normal element in brickwork. Unit 1 clearly comes to view as the center of unit 5; unit 2 appears in 6; unit 3 in 7; and so on. It is by the treatment of these units, each of which in itself is a bond pattern, that various patterns may be worked out on the surface of the wall by the proper handling of the shades and textures in the brick, or of the mortar joints.

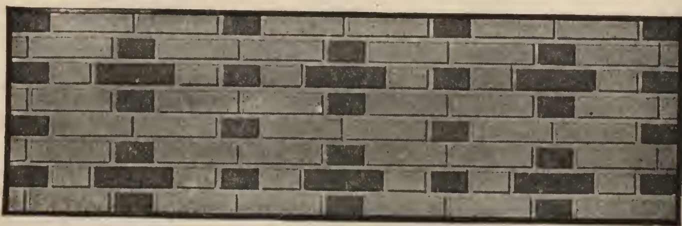


FIG. 4,162.—Three brick dark diamond units, zero pattern shift, three header separation

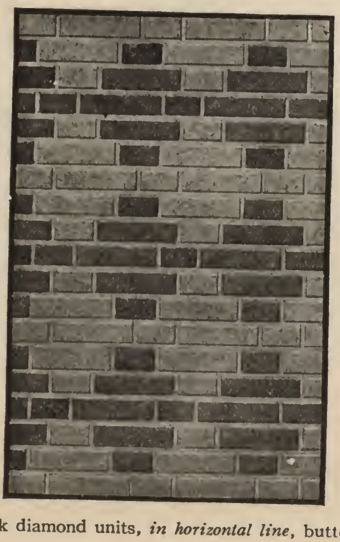


FIG. 4,163.—Six brick dark diamond units, *in horizontal line*, butted or zero separation.

The units may be made to join, or "butt," each other vertically an horizontally; or they may be separated by introducing between them or

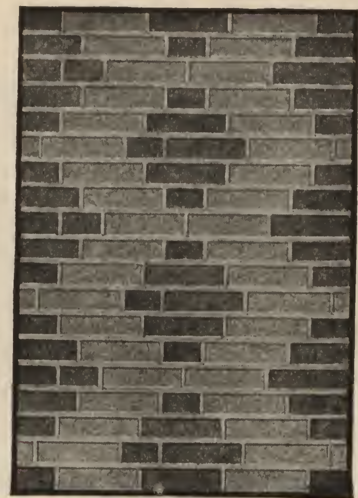


Fig. 4,164.—Six brick dark diamond units, *in diagonal line.*

Fig. 4,165.—Ten brick dark diamond units in horizontal line zero separation.

or more courses above and below, or variously arranged rows of brick in a general vertical direction on the side, as may be seen in the accompanying diagrams. When separated, the units are said to be surrounded by horizontal and vertical borders. And much of the artistic value of the

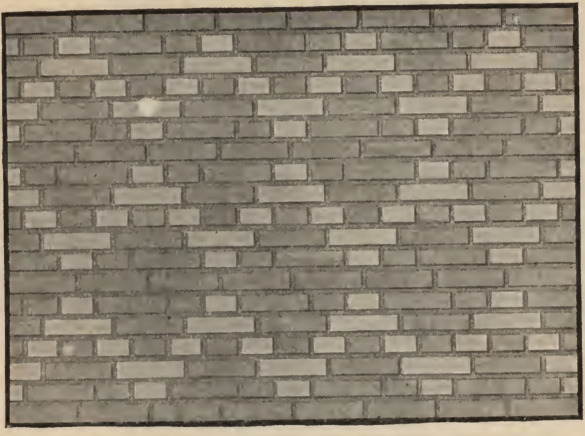


FIG. 4,166.—Ten brick dark diamond units in diagonal line, one course overlap.

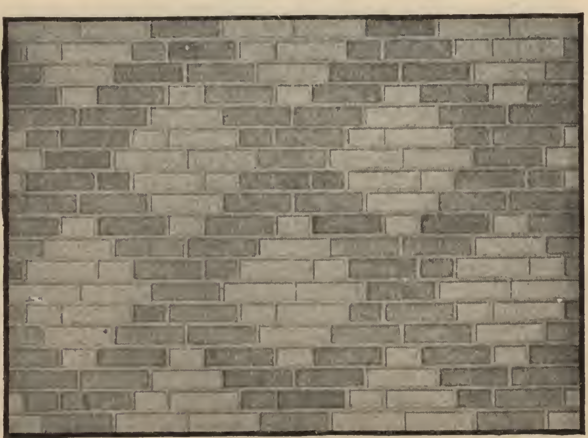


FIG. 4,167.—Combined ten brick light diamond units and dark cross diagonal separators.

pattern will depend upon the skill and taste with which these borders are worked out.

The designer in brickwork is urged to remember that the

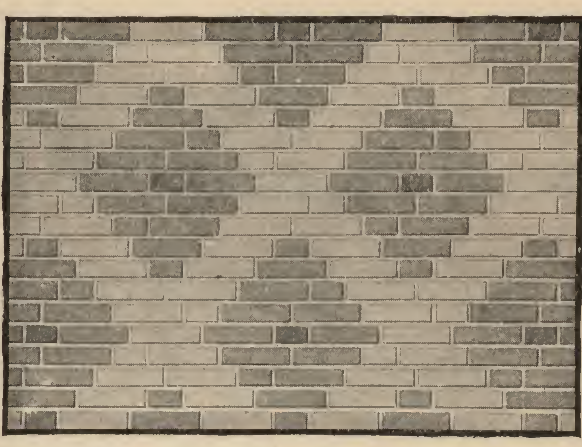


FIG. 4,168.—Combined fifteen brick dark diamond units and light cross diagonal separators.

FIG. 4,169.—Thirty-nine brick hollow diamond units in diagonal line, two course overlap.

use of pattern bonds obligates him to pay the strictest and most thoughtful attention to the beginning and ending of the pattern, either at the bottom or top of the structure, or on piers as they occur separately or between windows. He must first decide on a unit which is suitable to the size of the panel to be covered, and then exactly center it upon the panel, so that his pattern may end in a symmetrical manner, both laterally and vertically. In order to secure vertical symmetry the panel must always have an odd number of courses, that is, an even number on each side of the median line.

Treatment of the Units.—The accompanying illustrations figs. 4,153 to 4,161 show appearance of the units in wall pattern and indicate the way to treat the shades and textures of brick in designing patterns. The illustrations are by no means intended to dictate what may or may not be the best shade combinations in any given bond, what the blendings of light and shade or the contrasts of color and texture in brickwork, but merely as suggestive hints for pattern design.

At the same time, an underlying principle is involved in what has been thus suggestively presented.

It will be readily understood that the smaller units, which are worked into patterns of finer texture and quieter shadings, are more appropriate for wall expanses of limited area, while the bolder outlines and heightened contrasts of the larger figures are more suitable for large sweeping wall surfaces.

CHAPTER 71

Thickness of Walls

The various arrangements of brick in bonding being more or less complicated, the author has tried to simplify the subject by treating first of the exterior brick forming the face of the wall as in chapters 69 and 70, before presenting the methods of arranging the brick lying in the interior.

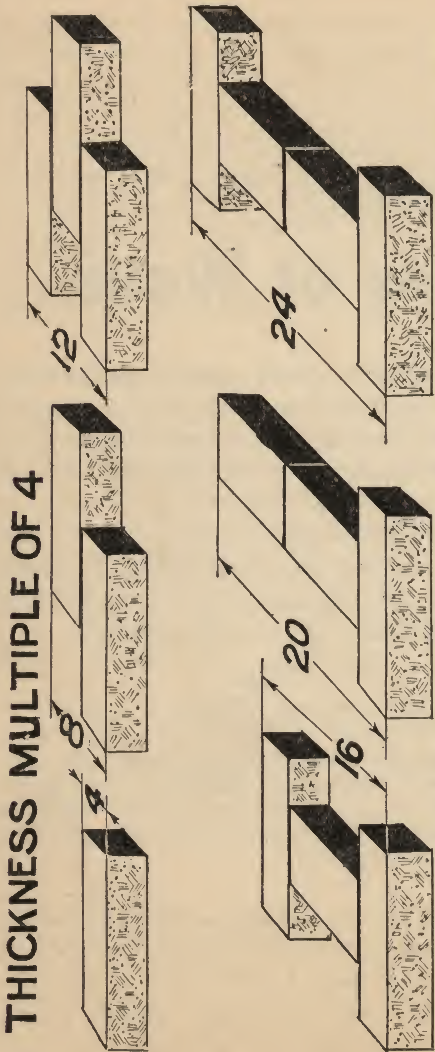
Evidently by placing the brick endwise or crosswise, a wall may be built of any thickness; *that is, a* ***multiple*** *of the* ***width*** *of the brick*. Thus taking the nominal width of the brick as 4 ins., then the nominal thickness of the wall may be:

4, 8, 12, 16, 20, 24 inches.

This is readily seen in figs. 4,170 to 4,175.

Evidently these multiple arrangements for producing the different thicknesses of wall may be made up in various combinations of stretchers and headers as shown in figs. 4,176 to 4,191. From the viewpoint of bonding a great variety of course arrangements is possible, and if desired no two successive courses need be of the same kind.

Four Inch Walls.—Although this thickness of wall is seldom used for bearing purposes. Often it may be legitimately used for interior non-bearing partitions, and for this use is desirable because it is fire resistive. Such partitions should either extend up from the basement below or be carried on steel

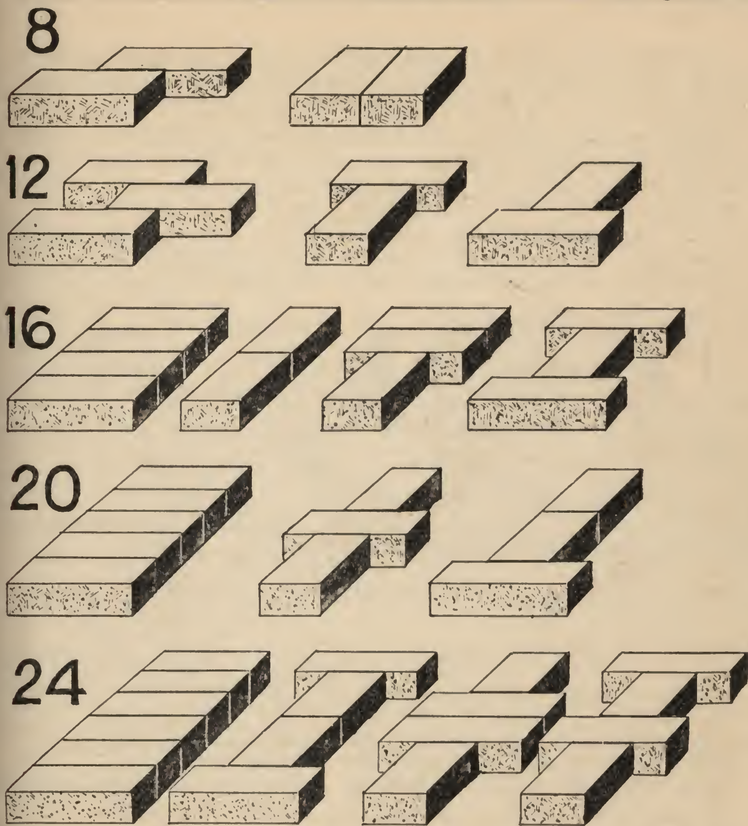


FIGS. 4,170 to 4,175.—Diagram showing that walls may be built of *any thickness that is a multiple of the width of the brick.*

joists at the basement ceiling level supported on brick piers.

In European countries it is standard construction to use 4 in. brick walls for bearing and non-bearing partitions, frequently built three stories high and support the joists at each floor level. Non-bearing partitions of brick on edge are also extensively used but the author does not recommend this practice.

Four Inch Veneered Walls.—Sometimes dwellings and other buildings that are three or even four stories high, are built with the inner walls of frame construction, and this frame is covered or *veneered* on the outside with a 4 in. facing of brick.



FIGS. 4,176 to 4,191.—Various arrangements of brick for laying walls of 8, 12, 16, 20 and 24 in. nominal thickness.

NOTE.—***Efflorescence on brickwork.*** A white efflorescence often appears on brickwork, especially in moist climates and damp places. It may spread over large areas of the wall surface although originating in the mortar joints. Soluble salts, principally of soda, potash and magnesia, in the cement or lime mortar, are dissolved by the water absorbed by the mortar and later precipitated on the surface of the brickwork as a white deposit, when the water evaporates. This deposit seems to be greater with the natural than with the Portland cement mortars and still heavier with lime mortar. The origin of the efflorescence may be in the bricks themselves as well as on the mortar used. This is the case when the bricks are made from clays containing iron pyrites or burned with sulphurous coal. Moisture in such bricks tends to dissolve the sulphate of magnesia and sulphate of lime, which in the evaporation of the water, are deposited on the surface as crystals of these salts.—*Kidder.*

True, the brick veneer makes a warmer house in winter and is fire resistive, but why not pay a little more and get the full advantages of brick construction, or if the outlay be limited, build a smaller brick house.

Brick veneering may be applied to new or old building. In new construction the studding is not placed at the face of the foundation wall, but set at the back of the wall, allowing sufficient space in front of the sheathing for the veneer of face brick. The studs are then sheathed as for the usual frame building and covered with building paper, held in place with 2×1 or 1×⅝ furring strips laid on vertically or horizontally over each lap of paper and once between. The face brick, set one inch from

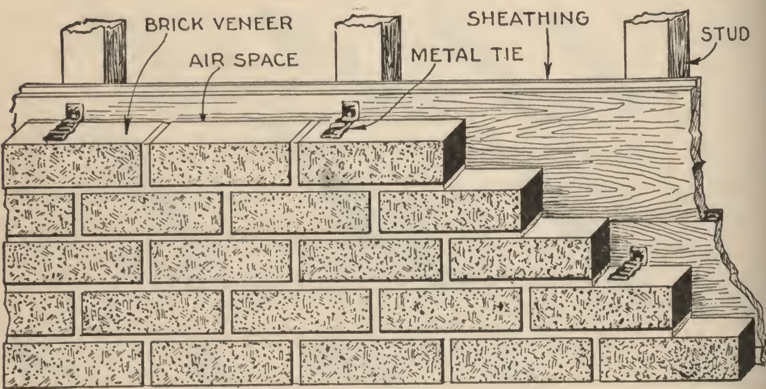


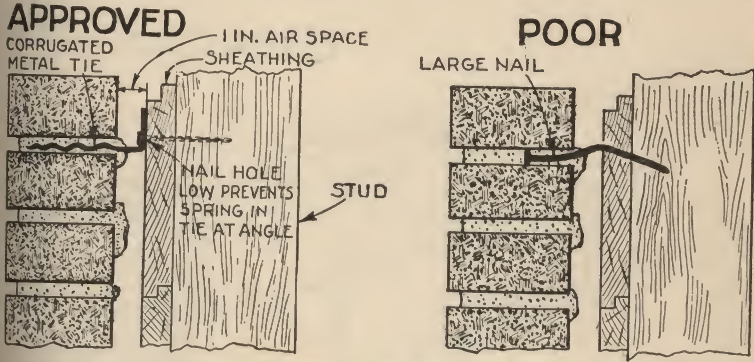
FIG. 4,192.—Brick veneer construction, showing the usual sheathed frame with bricks set one inch out (providing air space) and bonded with corrugated metal ties.

the sheathing, are laid up, so far as the outer bond is concerned, in the same manner as for facing the solid masonry wall, and are fastened to the frame work by metal ties spaced horizontally about on every stud and vertically every four or five courses, as shown in fig. 4,192.

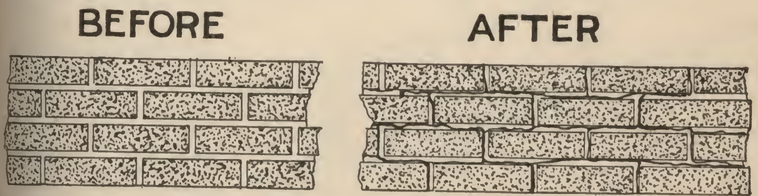
A brick wall is an unyielding mass, whereas a frame house is just the opposite. With these directly opposed inherent features the combination of the two methods of construction into one composite unit may be unsatisfactory unless the frame portion of the structure be substantually built.

Fig. 4,196 shows the result of the unstableness of the wooden building covered by brick veneer. On this account it is customary to lay the brick veneer with stripped joints so the cracks will not be visible.

Brick window sills with this type of construction are the same as for the solid masonry wall, except that the inner ends of the brick must be cut to fit against the sheathing. The window and door frames are set in place as in frame construction. While the brickwork over openings may be carried on arches, steel angles are almost universally used for this purpose.



FIGS. 4,193 and 4,194.—Corrugated metal ties and bent nails in bonding brick veneers. Nail ties are very objectionable.



FIGS. 4,195 and 4,196.—Before and after depreciation of brick veneer. The "rocking" of the flexible wooden frame during wind storms or other causes of vibration may cause the unyielding brick veneer to crack as shown in fig. 4,196. To guard against this trouble, the frame should be of substantial construction and well braced.

The brick porches should have the porch walls and piers of solid brickwork faced on both sides, with bond pattern or ornamentation following, in the main, the design of the house walls. Chimney construction for the veneer house is the same as for the brick house, except that care should be taken in setting outside chimneys clear of the sheathing so as not to cut into the frame construction.

Brick veneer is often applied to old buildings that have depreciated to

such an extent that repairs to restore them would be prohibitive. In such cases a brick veneer is sometimes applied giving the structure the appearance of a brick building.

In brick veneering on old buildings, first an eight inch concrete footing should be placed against the outside of the existing foundation wall, extending from grade to below frost line and resting on good solid soil. The brick veneer, starting from this footing, is carried up with an inch air

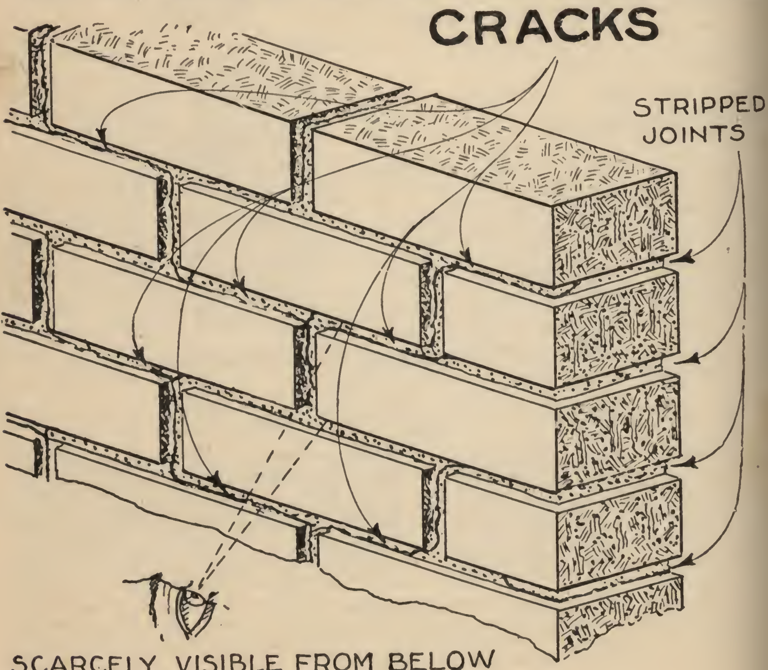


FIG. 4,197.—Reason for stripped joints with brick veneer.

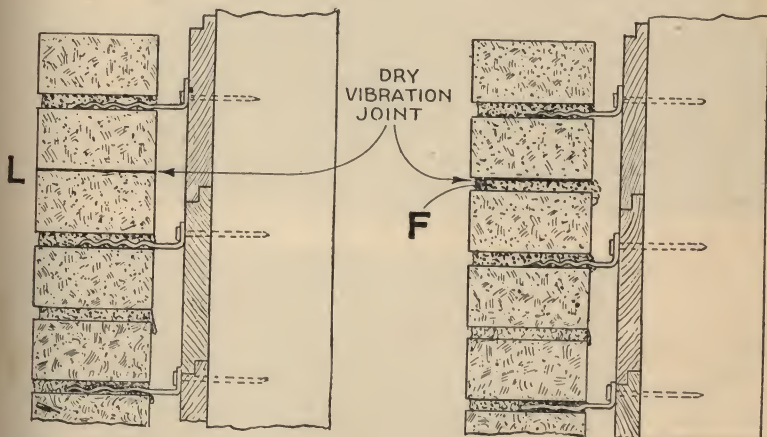
space between it and the old siding (which is not removed) and tied, preferably by corrugated metal ties, as in fig. 4193, or by driving thirty-penny nails through the siding or other finish into the sheathing and studs as in fig. 4,194.

Steel lintels are used over window and door openings. Where the veneer is to be carried over porches or other low additions, the siding

immediately above the roof should be removed and a steel angle placed against the sheathing, and securely attached to the studs by lag screws, so that no weight of the brickwork comes on the roof.

The brickwork is laid up to the door and window trim and a staff bead moulding, in the corner formed by the brick, securely nailed to the old trim, making a tight joint. Similar mouldings should be placed at the under side of roofs, porch ceilings and like places where the brick meets the old frame finish.

Figs. 4,200 and 4,201 show the application of brick veneer to old buildings.



FIGS. 4,198 and 4,199.—Author's vibration joint for brick veneer to prevent cracks. Where the veneer extends a large number of courses, an occasional course laid dry as at L, fig. 4,198, will render the brick mass flexible, thus allowing it to follow the movements of the studs when the house vibrates as in a wind storm. If it be desired to preserve the joint spacing, a layer of mortar or cement can be applied as at F, fig. 4,199, and allowed to harden, after which the next course are laid on it dry. Note that in the adjacent joints above and below the vibration joint, metal ties should be used.

Eight Inch Walls.—It is claimed that a thickness of 8 ins. for brick walls of the usual home is ample, yet there are numerous cities which do not allow walls under 12 ins. thick. Some thirty-five cities allow an 8 in. wall for both stories of a

FIG. 4,200.—Brick veneer on old building, I. Start of veneer for specially constructed foundation. Note wall ties on top course of brick.

FIG. 4,201.—Brick veneer on old building, II. Veneering second story above extension. Note angle irons and work at windows.

two-story house, and many thousands of dwellings have been constructed in these cities with 8 in. walls. Further, no city that has adopted the 8 in. wall has changed back to the 12 in. walls.

The discriminating, however, who wish first class construction

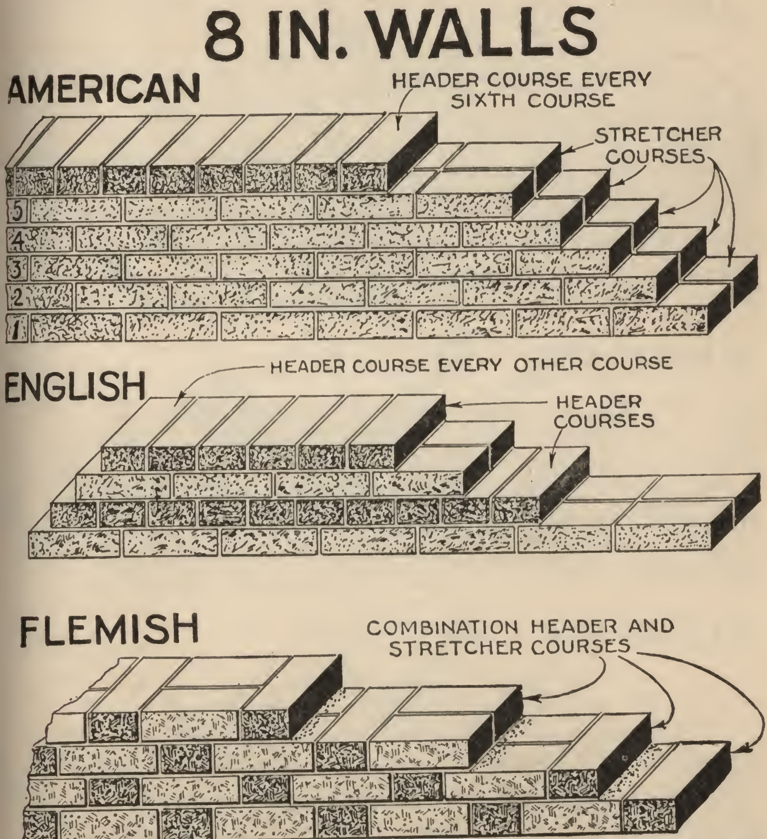
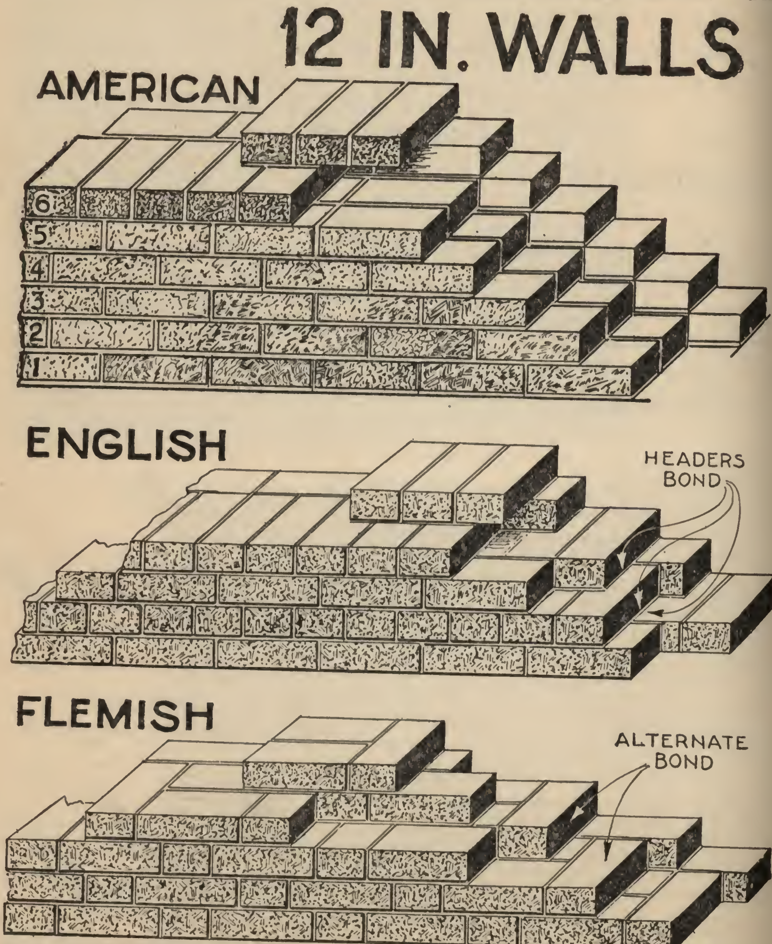
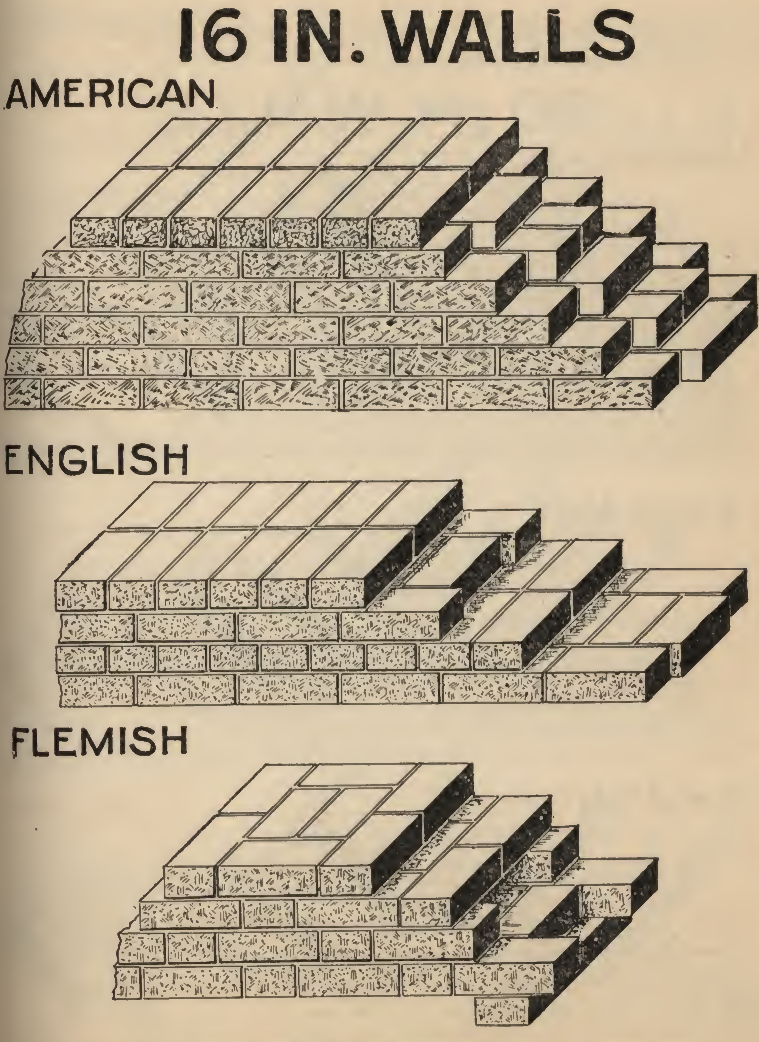


FIG. 4,202 to 4,204.—***Eight inch walls*** laid in various bonds. Note in figs. 4,202 and 4,203 relation of brick in stretcher courses: *½ front and back lap.*

will insist on 12 in. walls. Some cities require 16 in. walls, but this is a ridiculous waste of material and labor. The

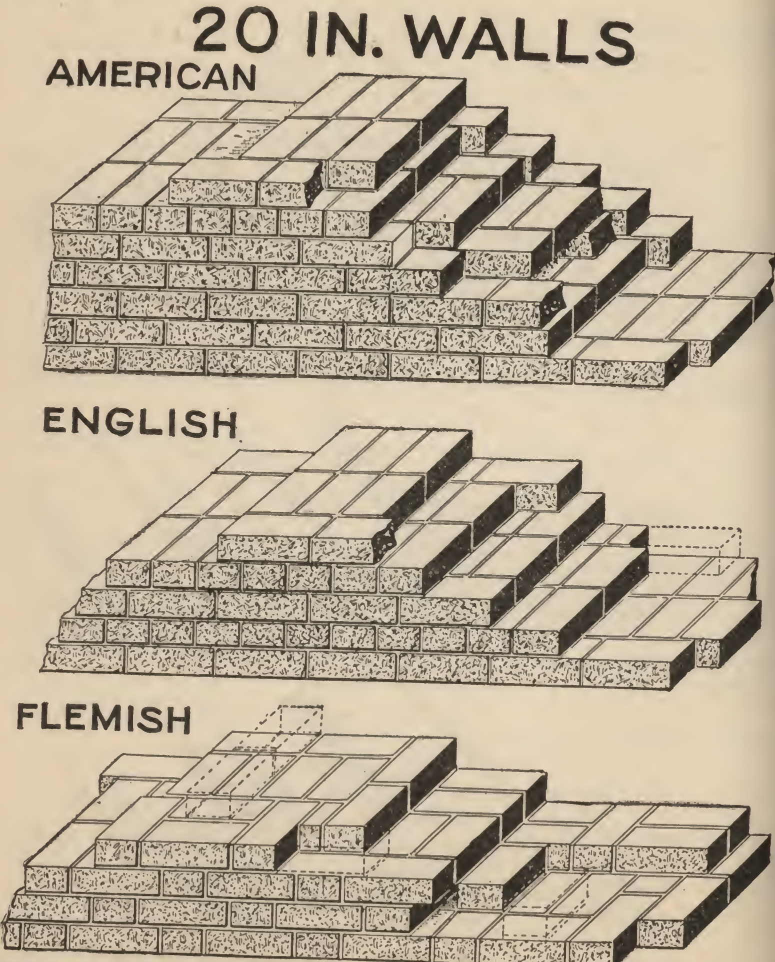


Figs. 4,205 to 4,207.—***Twelve inch walls*** laid in various bonds. In the American Bond note alternate arrangement of the bonding course as in courses 5 and 6.

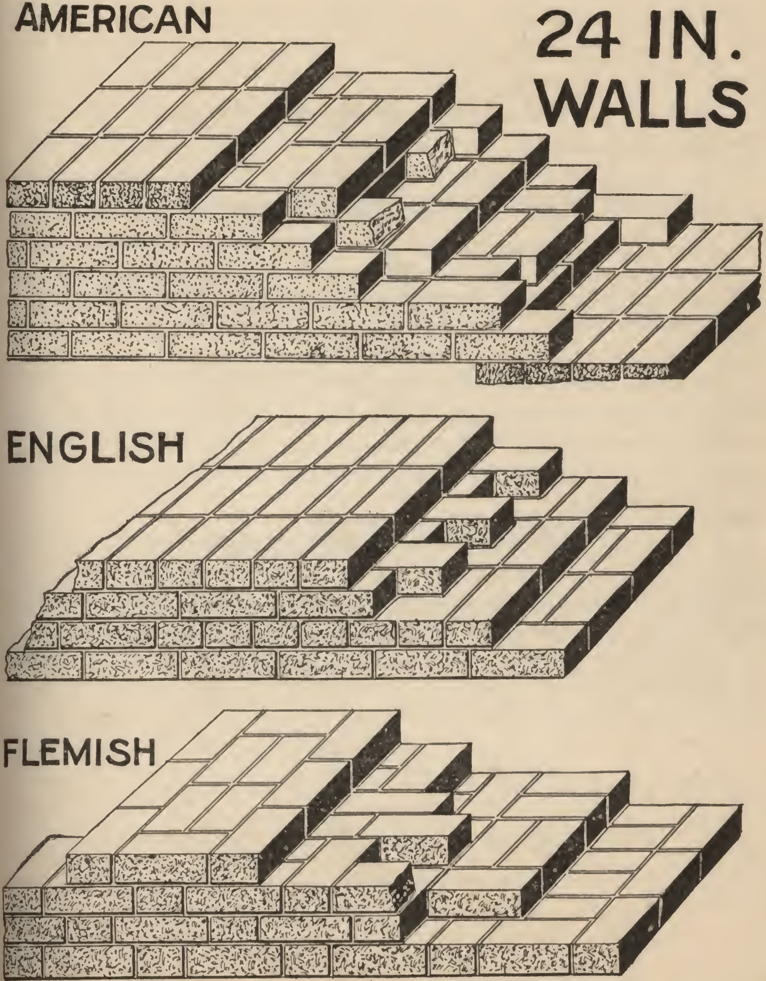


Figs. 4,203 to 4.210.—***Sixteen inch walls*** laid in various bonds.

brick arrangement for 8 in. walls in the various bonds are shown in the accompanying illustration.



FIGS. 4,211 to 4,213.—*Twenty inch walls* laid in various bonds.



FIGS. 4,214 to 4,216.—*Twenty-four inch wails* in various bonds.

Twelve Inch Walls.—For ordinary dwellings, an objection to 12 in. walls is the extra space taken up as compared with 8 in. walls; the excess thickness reduces the area of the rooms in the house, which in cities where land is very valuable must be taken into consideration. For a house 20×30 approximately 31 sq. ft. of area is thus lost on each story, an area equal to a small bath room or several good closets.

The extra thickness of the 12″ walls, however, insulates a house better against cold or heat resulting in a warm house in winter and a cool one in summer. See accompanying illustrations for brick arrangements in the various bonds.

Sixteen Inch to Twenty-four Inch Walls.—For heavy duty, as in factory construction where the walls have to carry heavy loads of machinery and are subjected to more or less vibration, the walls may be 16 to 24 ins. or more in thickness depending upon conditions.

The arrangement of the brick is more complicated for these thick walls and the accompanying illustrations have been prepared with progressively extended courses like steps so that the brick arrangement in each course can be clearly seen. These details for 16 to 24 in. walls are shown in figs. 4,208 to 4,216.

CHAPTER 72

Corners and Intersections

As distinguished from each other, a corner is *the meeting of the ends of two converging walls,* whereas, an intersection is *the meeting of one wall with another wall at some intermediate point.* In the case of intersections, one wall may end at the point of intersection, or continue. These distinctions are shown in figs. 4,217 to 4,219.

1. Corners

The corner, which is the beginning or end of a wall, is the point where the bond starts; it is here that means must be provided so that the courses may be shifted the amount required by the bond employed. Evidently this is obtained by the proper arrangement of the brick at the corner and by the use of special brick if necessary.

The various kinds of corners encountered may be classed:

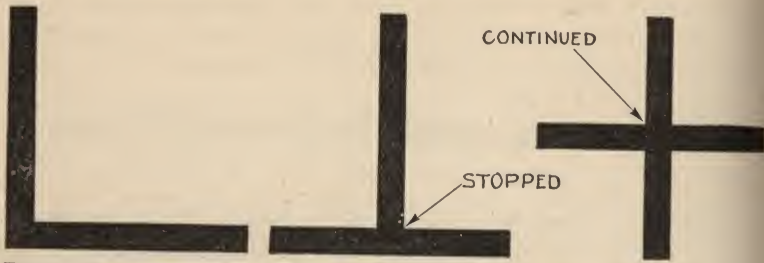
1. With respect to the angle of the walls, as:

    a. Acute.
    b. Square (90°).
    c. Obtuse.

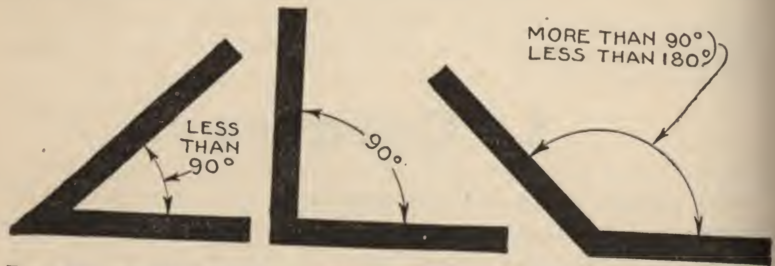
2. With respect to the direction of angle, as:

    a. Outside.
    b. Inside.

These various kinds of corners are graphically defined in figs. 4,220 to 4.223.



FIGS. 4,217 to 4,219.—Distinction between corners and intersections. Fig. 4,217, corner; fig. 4,218, stopped intersection; fig. 4,219, continued intersection.



FIGS. 4,220 to 4,222.—*Various corners, 1.* Fig. 4,220, acute; fig. 4,221, "square" or 90°; fig. 4,222, obtuse.

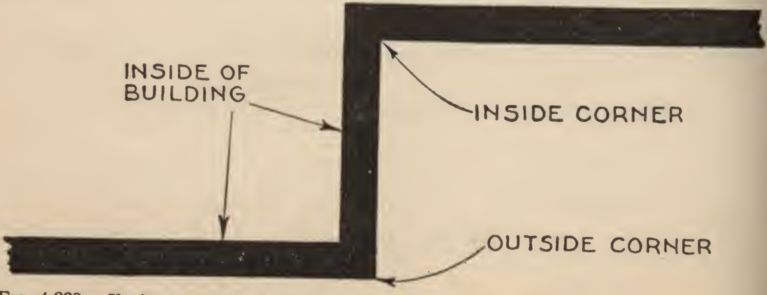
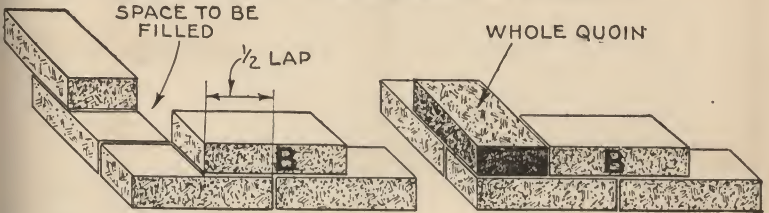


FIG. 4,223.—*Various corners, 2.* Outside and inside.

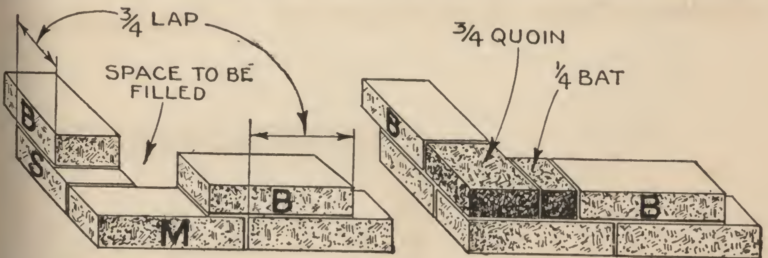
Starting the Bond at 90° Corners.—Evidently to start the bond in two walls diverging from a corner some special arrangement of the brick is necessary, otherwise the courses would not have the required *shift* resulting in incorrect lap. The brick used for this purpose are, as explained in chapter 69:



Figs. 4,224 and 4,225.—Corner arrangement for stretcher bond 4 in. wall, ½ lap.

1. Quoins.
2. Closers.
3. Bats.

With these forms, various spacings may be obtained so as to obtain the proper lap in starting the bonds. The numerous



Figs. 4,226 and 4,227.—Corner arrangement for stretcher bond 4 in. wall, ¾ lap.

spacing combinations that can be made are illustrated fully in chapter 69 on Bond, figs. 4,072 to 4,081. The following rule should not be violated.

A course should be started with a quoin, never a ¼ closer.

That is, the end brick should never be less than 4 ins. in width. Sometimes ¼ closers are used but this is very bad practice and cannot be too strongly condemned.

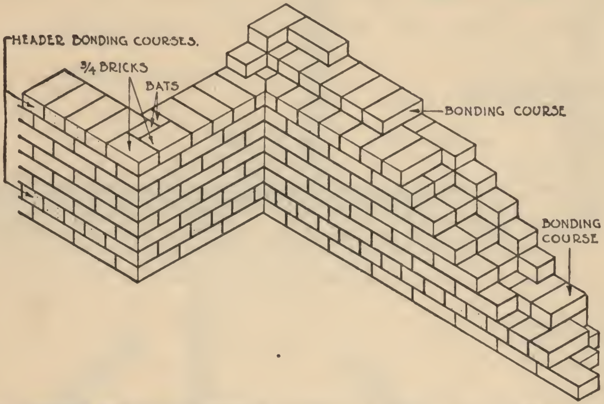


FIG. 4,228.—Outside and inside corners in common or American bond, 8 and 12 in. walls.

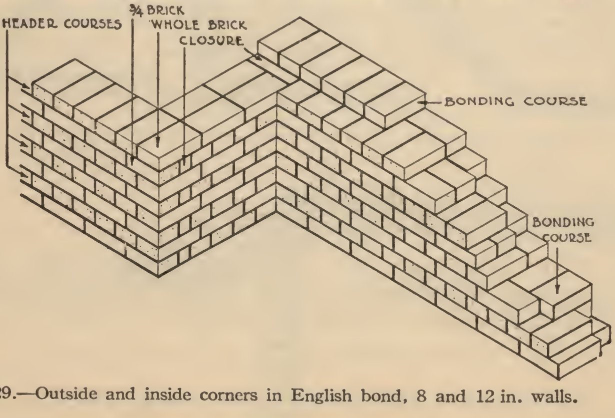


FIG. 4,229.—Outside and inside corners in English bond, 8 and 12 in. walls.

In starting a bond at the corner the requirements of both walls must be considered so that proper quoins and closers may be selected. The examples which follow illustrate the method of solving the problem:

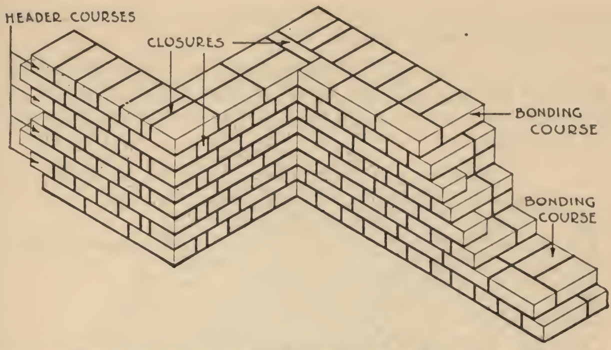
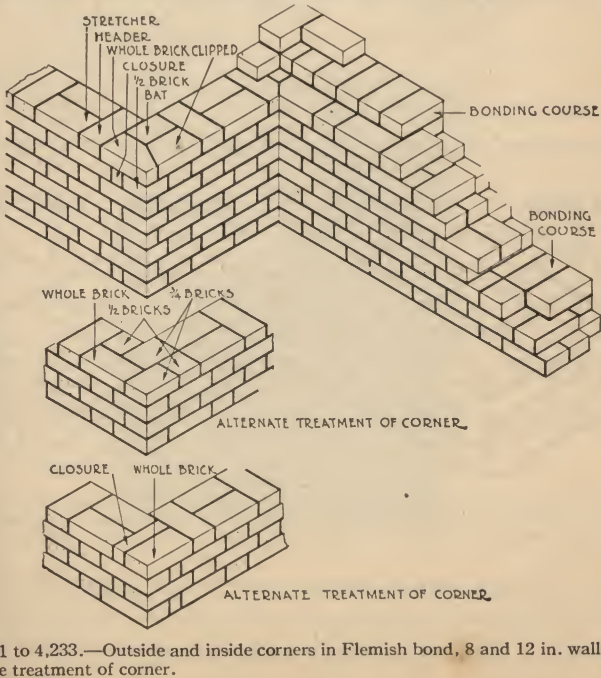


FIG. 4,230.—Outside and inside corners in English cross or Dutch bond, 8 and 12 in. walls.



FIGS. 4,231 to 4,233.—Outside and inside corners in Flemish bond, 8 and 12 in. walls, showing alternate treatment of corner.

Example.—Determine the brick arrangement at corner for stretcher bond 4 in. wall, ½ lap; ¾ lap.

Case 1, ½ lap.—This is the simplest case. In fig. 4,224 the bond starts with brick B, leaving ½ brick to be covered to the edge and requiring a whole brick length on the other wall. Hence a whole quoin or end brick wlll fill the space.

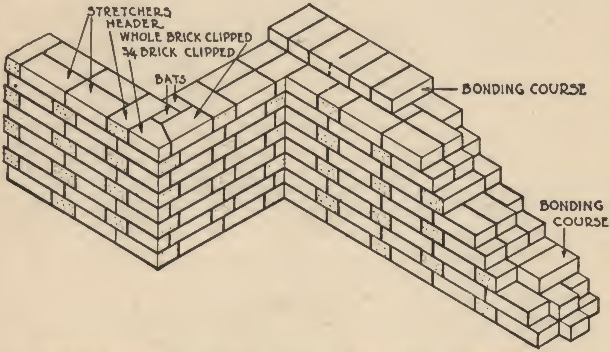


FIG 4,234.—Outside and inside corners in garden wall bond, 8 and 12 in. walls.

FIGS. 4,235 and 4,236.—Outside corners formed with and without closers. ***In English bond*** a header split in half or *closer* is used, but ***in Dutch bond*** the closer is eliminated and the same effect obtained by using a ¾ quoin in the stretcher courses.

Case 2, ¾ lap.—The first bond brick B, fig. 4,226, will have ¼ lap on end stretcher M, leaving ¾ of M, to be covered. On the other wall ¼ of S, is to be covered or ¾ each way. Hence a ¾ quoin and a ¼ bat closer is required to fill the space as shown in fig. 4,227.

The above examples, together with the explanations give in figs. 4,072 to 4,081 of chapter 69 should be ample to sho how the brick may be arranged to meet various conditions

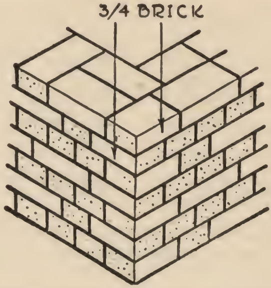


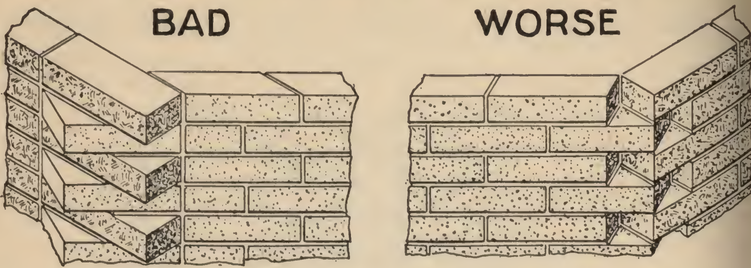
FIG. 4,237.—English cross or Dutch bond corner started without closers.

FIG. 4,238.—Bricklayer laying a corner, common bond.

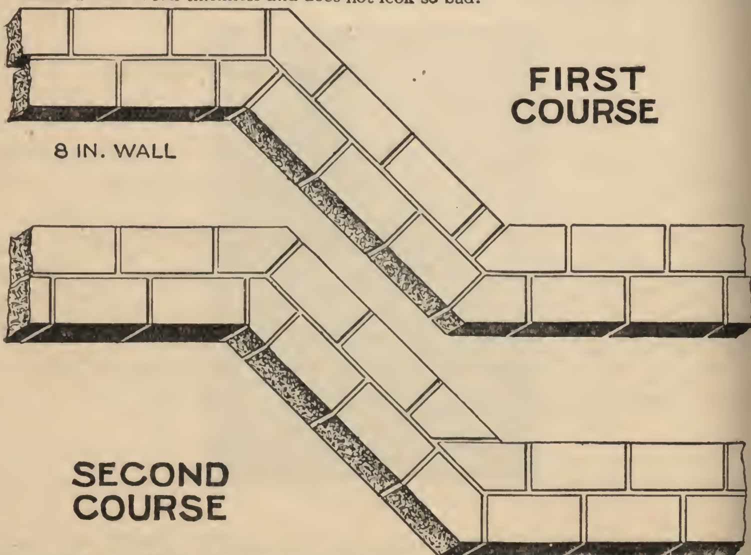
Both outside and inside corners for the various bonds for walls of various thickness are shown in figs. 4,228 to 4,237.

Obtuse Angle Corners.—If the angle of turn be 30°, 45° or

60°, specially shaped brick made for the purpose and called splay or octagon brick, may be obtained from dealers or



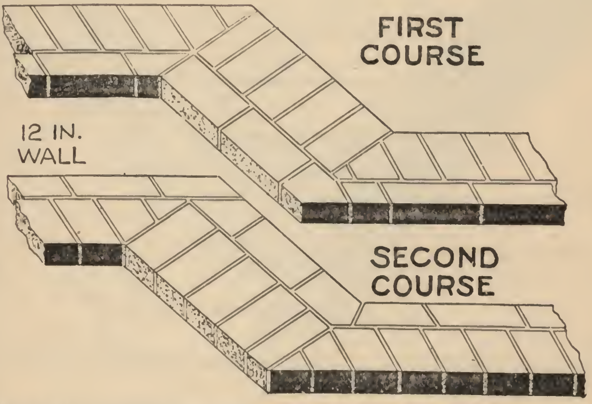
FIGS. 4,239 and 4,240.—Outside obtuse angle corners with standard brick. The method shown in fig. 4,240 is used only in cheap work and should not be tolerated for it leaves ledges for the lodgement of snow and dirt, decreases the thickness of the wall and besides is rather unsightly. The only advantages of the method shown in fig. 4,239 over the one just described is that it makes a wall of full thickness and does not look so bad.



FIGS. 4,241 and 4,242.—Outside and inside obtuse angle turns with standard brick chipped 8 in. wall, ¼ lap stretcher bond. The brick at turns are arranged for the minimum amount of cutting.

manufacturers. If for any reason these special shapes be not available, the angles may be formed by the use of standard size brick.

There are two methods of using standard brick for outside corners as shown in figs. 4,239 and 4,240; both are objectionable as can be seen from the illustrations.

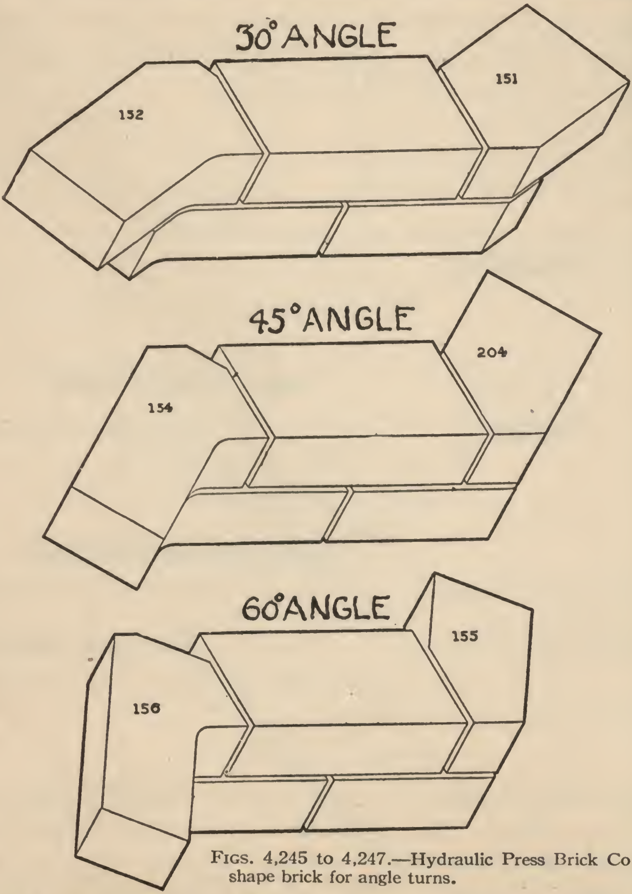


FIGS. 4,243 and 4,244.—Outside and inside obtuse angle turns with standard brick chipped; 12 in. walls English bond.

Figs. 4,245 to 4,247 show special brick for making standard turns of 30, 45 and 60 degrees.

Acute Angle Corners.—In the cheaper class of work, to save time, the "pigeon hole" method of making an acute turn is employed. In this method the wall is built out almost to a sharp edge, the brick being laid up with vacant indented spaces or pigeon holes on each side as shown in fig. 4,248.

The pigeon holes are the result of laying the brick with square ends instead of using special brick or chipping to shape. The pigeon holes form spaces for the accumulation of dirt, water, snow, etc., with result that the brickwork rapidly deteriorates and moreover is unsightly.



FIGS. 4,245 to 4,247.—Hydraulic Press Brick Co. special shape brick for angle turns.

The arrangement of the brick for a pigeon hole acute turn in English bond is shown in figs. 4,249 and 4,250.

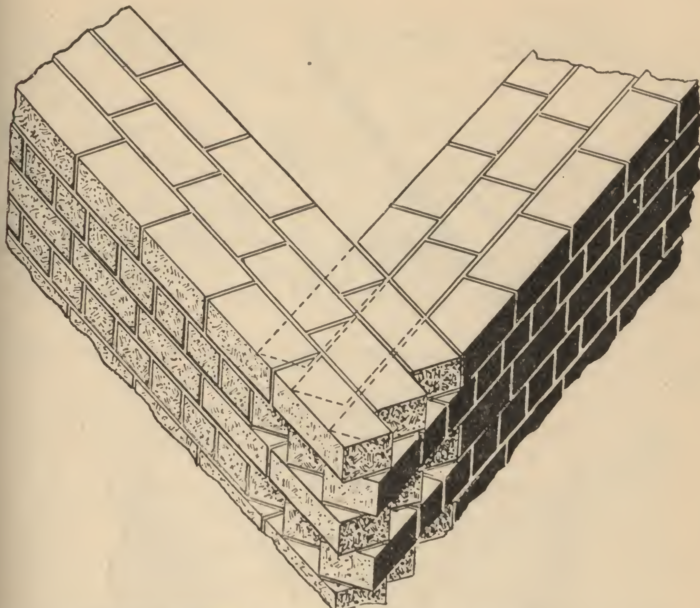
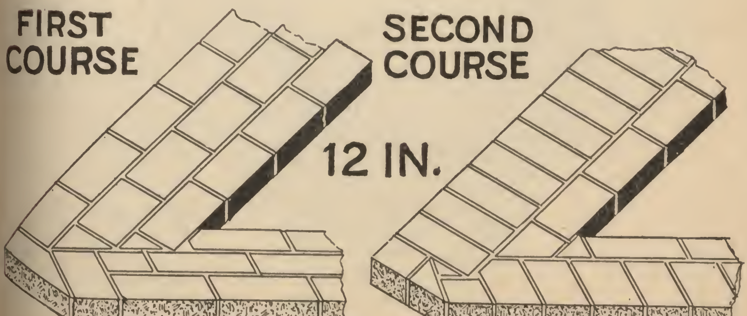
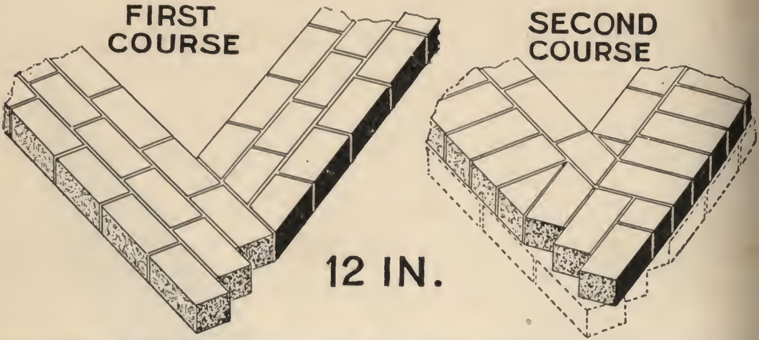


Fig. 4,248.—Appearance of pigeon hole acute angle corner in English bond; 12 in. wall



Figs. 4,249 and 4,250.—Acute angle corner with standard brick, 12 in. wall in English bond; *pigeon hole method.*



FIGS. 4,251 to 4,252.—Acute angle corner, 8 in. wall, common or American bond with standard brick.

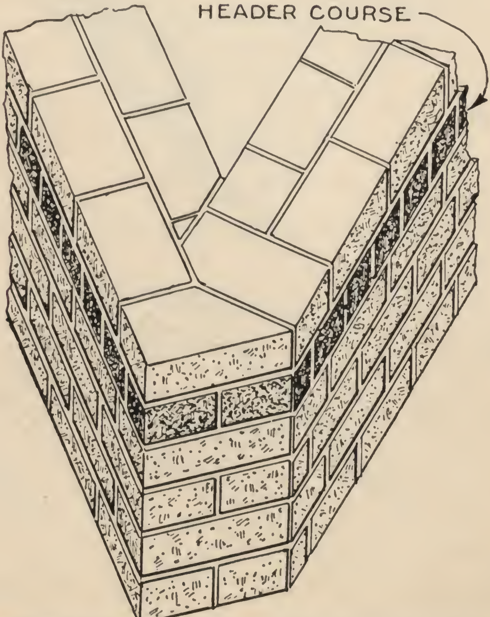
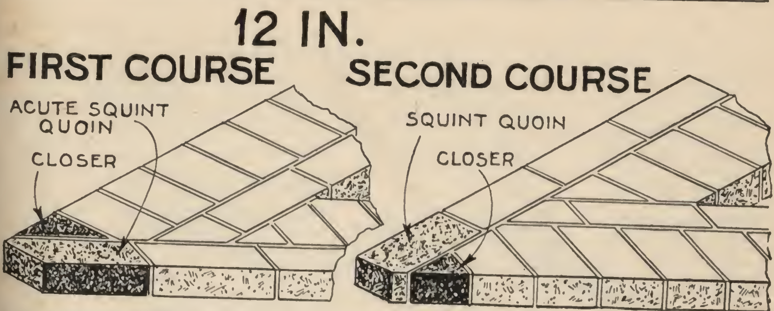


FIG. 4,253.—Appearance of acute angle corner, 8 in. wall, American bond with standard brick.



Figs. 4,254 and 4,255.—Acute angle corner, 12 in. wall, English bond with standard brick.

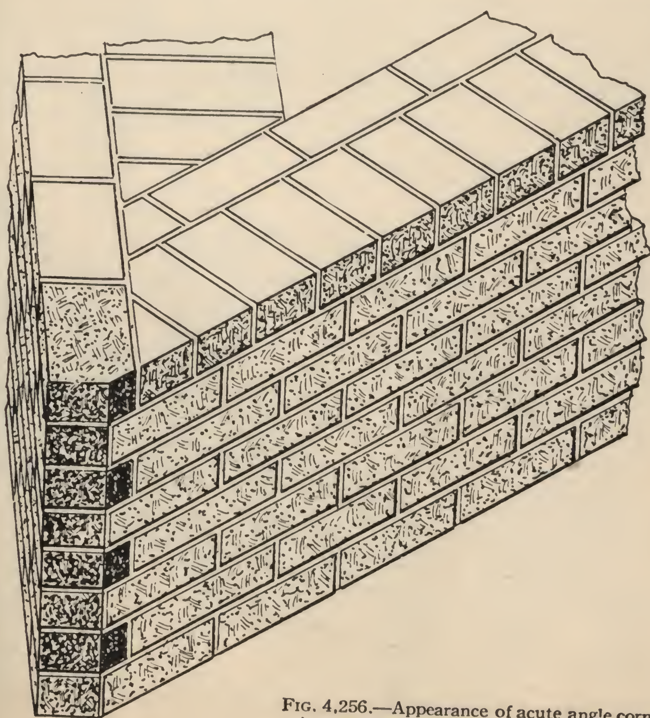
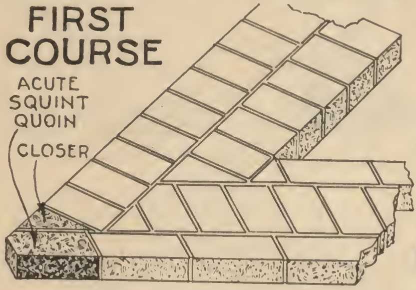
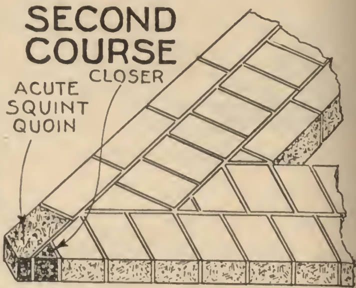


Fig. 4,256.—Appearance of acute angle corner, 12 in. wall, English bond with standard brick.

A better method of making an acute angle corner is shown in figs. 4,251 to 4,253. Here the sharp edge and pigeon holes are avoided, thus improving the appearance and leaving no spaces for lodgement of dirt, etc. This method is simple to lay up, as there is little chipping of the brick. Note in the header course in the figures. Acute turns for 12 and 16 in. walls English bond are shown in figs. 4,254 to 4,259.





FIGS. 4,257 and 4,258.—Acute angle corner 16 in. wall in English bond with standard brick.

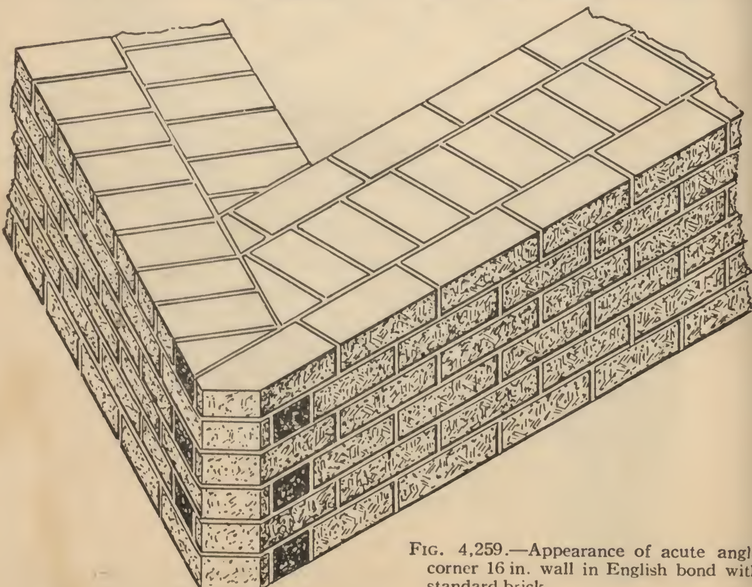
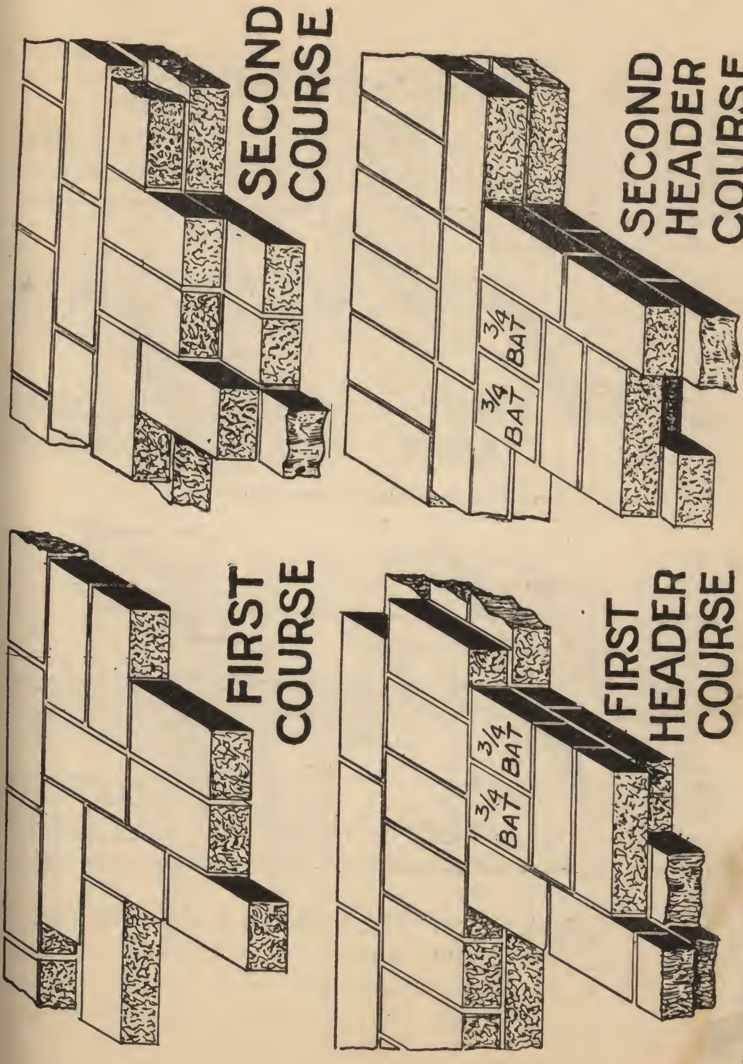


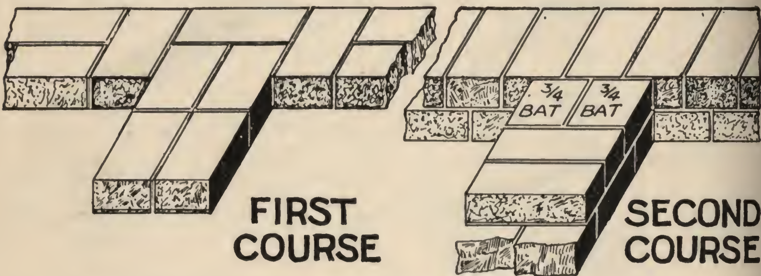
FIG. 4,259.—Appearance of acute angle corner 16 in. wall in English bond with standard brick.



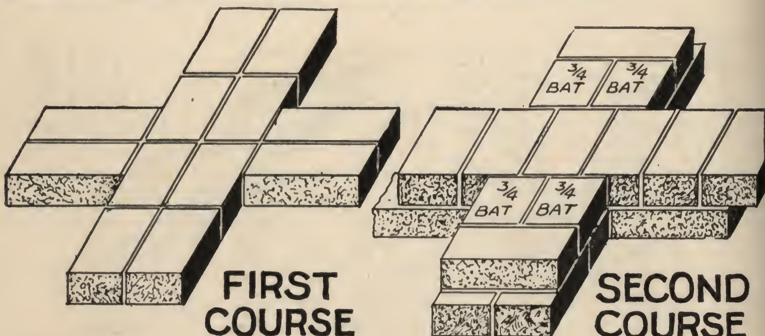
FIGS. 4,260 to 4,263.—Stopped intersection; 12 in. wall in common or American bond.

2. Intersections

The intersections of walls may be of two kinds: 1, *stopped* or L shape, and 2, *continued* or cross shaped. These intersections

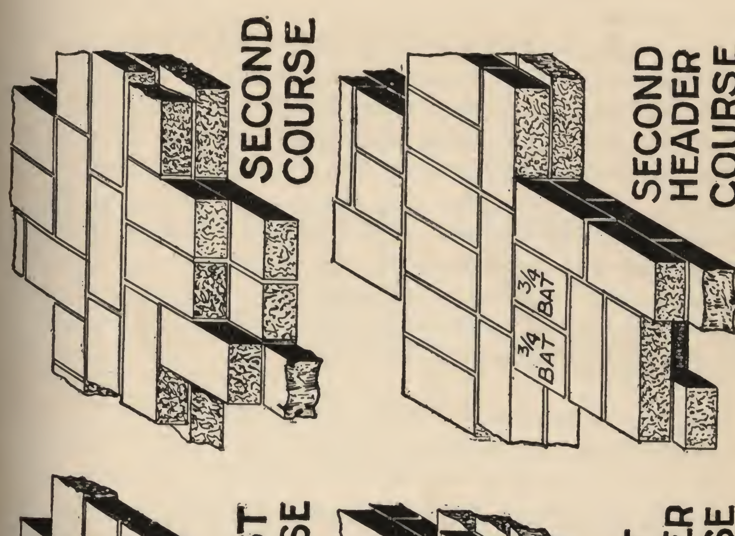


FIGS. 4,264 and 4,265.—Stopped intersection; 8 in. wall in English bond.



FIGS. 4,266 and 4,267.—Continued intersection; 8 in. wall in common or American bond.

are usually at right angles. The brick are arranged in various ways at these intersections depending on the wall thickness and kind of bond, the objects sought being to bond the two walls together at the same time preserving the bond in each wall.


SECOND COURSE
SECOND HEADER COURSE
3/4 BAT
3/4 BAT
FIRST COURSE
FIRST HEADER COURSE
3/4 BAT
3/4 BAT

Stopped Intersections.—This is the simple case of intersections, as illustrated in the intersection of a partition wall with the outer wall. In arranging the brick at the intersection, the aim should be to get the maximum amount of bonding. In the accompanying cuts figs. 4,260 to 4,263, this bonding area is shown shaded, thus in fig. 4,260 a half brick in each course is in bond; in fig. 4,262 a whole brick and two half bricks are in bond.

Continued Intersections.—Frequently an intersecting wall continues past the intersected walls forming a cross shaped figure. The same general principles apply as for stopped intersections, the aim being:

1. To get as much bond area as possible.
2. To preserve the bond in both walls.
3. To avoid chipped brick when possible.

The methods of brick arrangement for 8 and 12 inch walls common or American bond is shown in figs. 4,264 to 4,271. A study of these illustrations will show the general scheme to be followed and the student should practice by applying the principles here illustrated to the other bonds for walls of various thicknesses.

CHAPTER 73

Rectangular Openings

The term rectangular openings relates to those openings for doors, windows, etc., having straight instead of curved sides as are employed in arch work.

In bricklaying, the problem of discontinuing the bond or stopping off the brickwork for openings is not a difficult one when once understood. The bond should be worked out by the architect in designing the building so that the sizes and spacing of the openings will permit stopping the bond without irregular lap conditions; that is, the brick linear dimensions should, wherever possible, be calculated ***so as to reduce cutting to a minimum;*** the competent architect will attend to this. When the bricklayer is in doubt as to this, he should lay down a trial course in the bond selected, and arrange it to the best advantage for minimum cutting.

In doing this start at the opening and

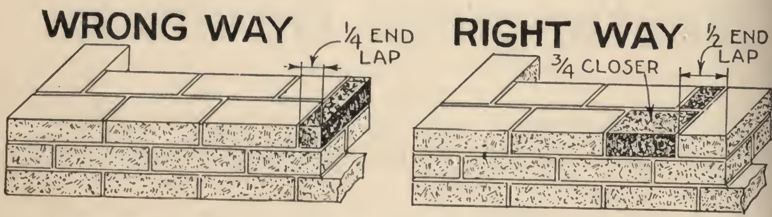
1. Never let the bond end at the opening with an end brick less than ½ lap.

2. If it require a ¼ lap brick to justify the bond, make this a closer placed *next* to the corner quoin or end brick at opening.

3. In ordinary work with common brick, avoid a ¼ lap brick by "stretching or compressing" the joints.

These three suggestions are illustrated in figs. 4,272 to 4,275.

Window Openings.—Window sills in brick buildings should be of brick or stone. Cement, unless pre-cast is not well adapted for the purpose. Brick window sills are preferable to stone, for besides adding to the appearance of the building, they are inexpensive since they are of the same material as the wall and placed by the same workmen who lay up the wall, thus obviating the necessity of additional labor to place the



FIGS. 4,272 and 4,273.—Wrong and right way to justify the bond at openings.

NOTE.—*Brick Sills.* The most inexpensive window sills are those of brick. The brick should be laid on edge and pitched or tilted to shed water. Brick laid flat with a pitch formed with cement are not satisfactory, as the action of the weather may cause the cement to loosen. Allow the bottom of the brick to project slightly beyond the face of the wall to form a drip. Door sills may be laid of brick, providing the brick is suitable for this purpose.

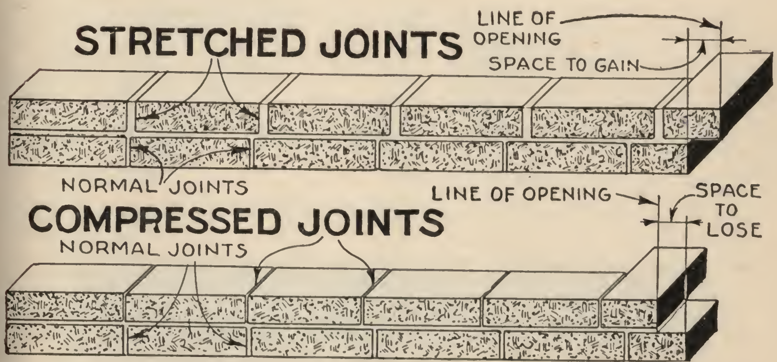
NOTE.—*Window and door frames.* The only difference between double hung windows for frame and for brick walls is that the latter are boxed in at the jambs to provide a housing for the weights and that they have a staff bead outside. It is cheaper, however, to buy stock frames for brick walls with the box in place than to have the carpenter on the job make the box. Window and door frames for brick walls are made by all millwork concerns.

NOTE.—*Setting window and door frames.* Window and door frames are set by the carpenter, window frames being placed on top of the sill on a thin bed of mortar. A much better job is made if they be set before the wall has risen above the sill level. They are levelled, plumbed, and braced so that the braces will not interfere with the placing of the scaffold. First floor frames are sometimes braced to stakes driven in the ground outside the house. The most convenient way, however, is to place an upright at about the center of a small house, braced in two directions near the bottom with short pieces of plank. All the window frames on the story are then braced to the upright with braces placed horizontally, near the top of the frame, sloping braces being entirely avoided. This provides clear working space under the braces and scaffolding can be moved around at will. The carpenter should pike a few brick on the sill to assist in holding the frame steady. If he fail to do this, the bricklayer should place them himself before starting to brick the window in. If a door frame or casement window frame be high, a cross piece should be nailed on the frame to prevent the window being lowed in. The box stiffens a double hung frame considerably.

heavy stone. Brick for sills should be laid on edge and pitched approximately at an incline of 1 inch in 6 to shed the water.

Fig. 4,276 shows how an opening for window is started and fig. 4,277 the inclined brick on edge upon which the window frame rests and inside course on edge for 8 in. wall.

A job of better finish is secured by use of special sill brick of which there are numerous patterns. Some of these shapes and method of laying is shown in figs. 4,281 to 4,290.



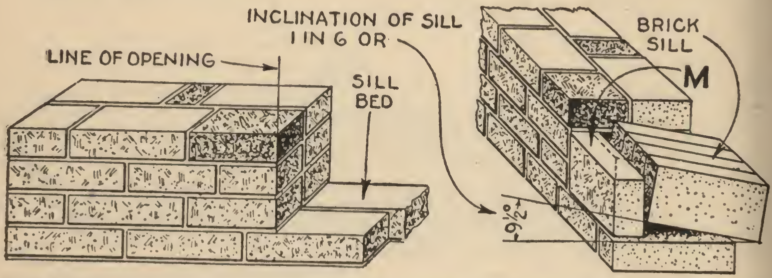
Figs. 4,274 and 4,275.—***Stretched*** and ***compressed joints.*** In common brickwork the bond may be justified with ½ lap at opening by making thick vertical joints (called "stretching the joints") in order to gain space as in fig. 4,274, or by making thin joints (that is compressing or shrinking the joints) in order to lose space. In both cuts the lower course of brick shows where the bond would end with vertical joints of normal thickness.

In laying a brick sill, to line the edge of the sill accurately, a plank should be fastened to the wall and the brick placed upon it, as shown in fig. 4,278, which shows also the way each brick is "buttered" with mortar before being pressed into place. 1.3, or, preferably, 1:2 cement mortar should be used. While the illustration shows a brick sill being placed under a steel frame after the latter is set, it is better construction to set the sill first. The latter should always be done *with a wood frame.*

To obtain the best effect, brick sills should be "slip sills" not wider than the actual masonry opening. Brick sills laid horizontally with a pitch formed with cement are not satisfactory, as the action of the weather may cause the cement to loosen.

In general, brick is the most satisfactory material for either window or door sills, although it may be made to form attractive combinations with other materials. Where brick is used throughout, however, no material has to be specially ordered.

An appearance of great solidity may be gained by sloping the brick window sills very sharply, thus apparently increasing the depth of the reveal of the windows.



FIGS. 4,276 and 4,277.—Construction of brick window sill, 8 in. wall. The pocket formed on top the inner stretcher brick indicated by **M**.

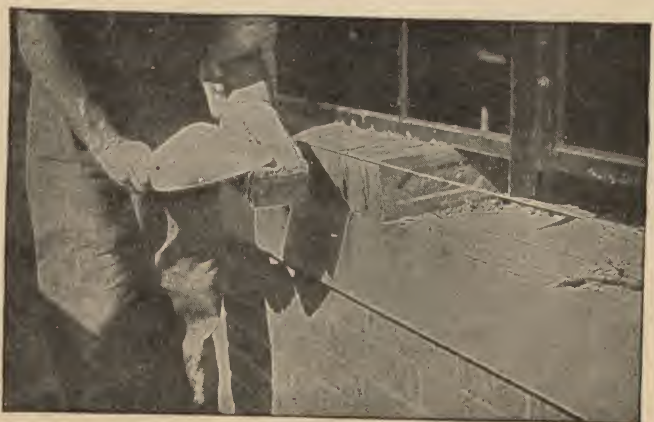


FIG. 4,278.—Laying brick sill. Note board on which brick are lined.

FIG. 4,279.—Wood lintel supporting brick over opening. Wood lintels should not be used to support brickwork on openings over 3 ft. because in case of fire the lintel will be consumed, or depreciate by decay.

The support over window or other openings is formed by *lintels* or by *arches*. The treatment of arches is explained in the next chapter.

A *lintel* is *the horizontal top piece of a window or doorway opening serving to support the brickwork* as in fig. 4,279.

It should be understood that the lintel is not a part of the window (or door) frame but serves to

support the brickwork so that no undue stress will be brought on the frame tending to distort it. This is shown in fig. 4,279.

A wooden lintel is all the support required for brickwork over openings three feet wide and less; for when the mortar is set, brickwork will support itself over spans of this width, even though the wood lintel should burn or decay.

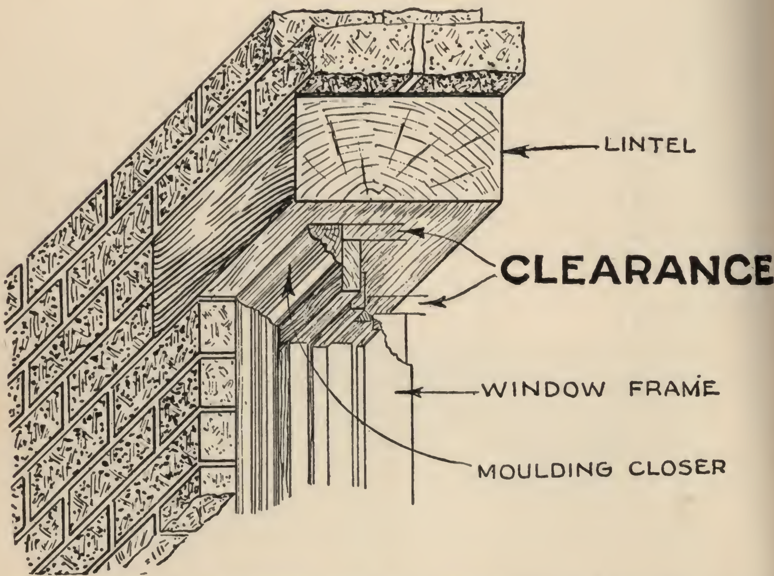
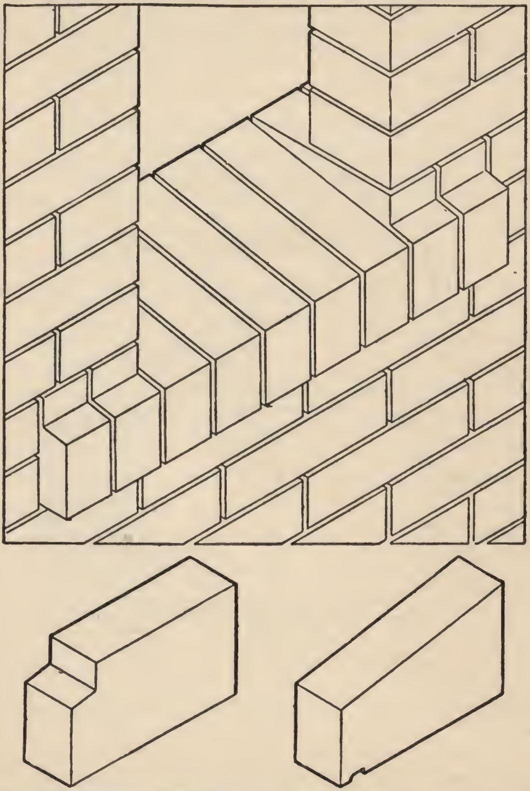


FIG. 4,280.—Wood lintel supporting brick over opening. Wood lintels should not be used to support brickwork on openings over 3 ft. because in case of fire the lintel will be consumed or depreciated by decay.

For openings wider than three feet, a brick relieving arch should be thrown over the lintel, bearing on the wall at the ends of the lintel and not on the lintel itself. The space between the lintel and relieving arch should be filled with brick-

work. This is built upon the lintel and shaped at the top to form a center for the relieving arch.

Where a flat soffit is desired a simple steel lintel may be used to support



FIGS. 4,281 to 4,283—Hydraulic Press Brick Co. special window sill brick. Fig. 4,281, assembly, fig. 4,282, end brick, fig. 4,283, intermediate brick.

the outside thickness of brickwork over an opening with a 4″ reveal. A 4″×3″ or even 3″×3″ steel angle is generally sufficient for openings up to 4 feet wide, wider openings up to 5 feet require a 3″×5″ angle. If the reveal is 8″, two angles back to back should be used, preferably riveted together.

If both sides of the wall be exposed, the whole thickness should be carried upon the steel.

If the floor joists above be close to the top of the opening below, care should be taken that the lintels are strong enough to carry them.

Before setting steel lintels, the surface and ends which will be buried and concealed in the masonry should first be thoroughly painted with graphite or red lead and oil.

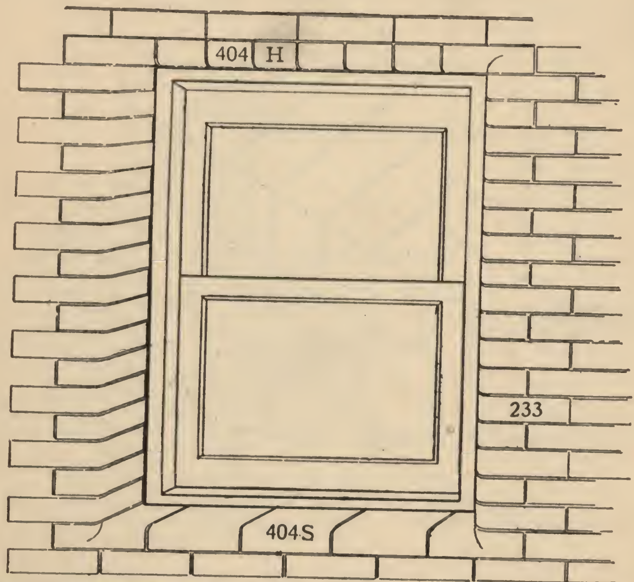


FIG. 4,284.—Hydraulic Press Brick Co. special window brick, showing special shapes for sill, top and jambs.

A soldier course of brick on end is frequently placed over a steel lintel.

Fig. 4,285 illustrates the use of both wood and steel lintels, the latter supporting a *soldier course* of brick, that is brick stood up on end. Very often the mistake is made of making this course wider than the opening. A much better effect will be gained by making it no longer than the width of the opening. Wood or steel lintels should generally be made 8 ins. larger than the opening giving 4 ins. bearing at each end.

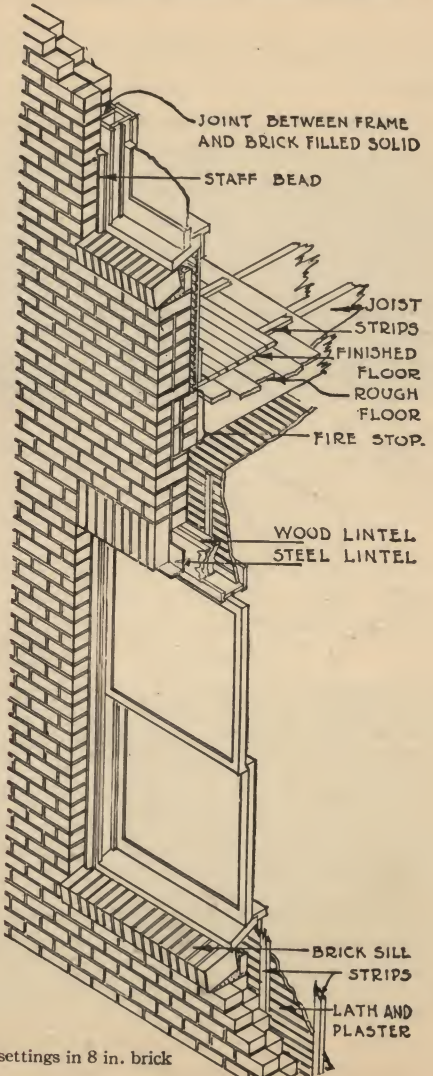
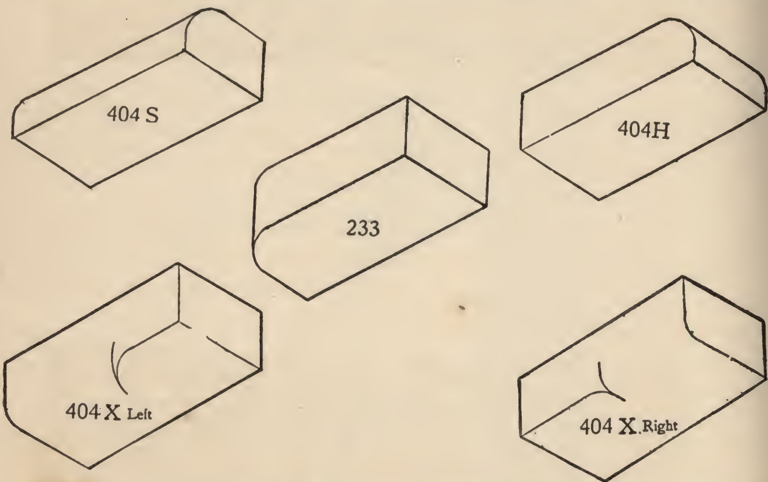


FIG. 4,285.—Window settings in 8 in. brick wall.

A stone lintel should not be relied upon to sustain the load of the wall above.

It is safer to support the stone with steel. Stone has uncertain transverse strength and may crack unless made too high for good proportion. A small mould of appropriate section over the top and at the sides of a stone lintel will produce a better effect than a flat lintel set flush with the brick wall, particularly where the lintel is three or more brick courses high. Do not use stone which contrasts too strongly in effect with the brick work or the elevation may be restless and "spotty."

Window Frame Sizes.—To facilitate readily obtaining sash



Figs. 4,286 to 4,290.—Hydraulic Press Brick special window bricks, showing entire shape of bricks used in the window setting shown in fig. 4,284, the letters corresponding. 404S, stretcher sill brick, 404H, header top brick; 233 jamb brick, 404X, left and right corner brick.

and exterior door sizes, contractors, so far as possible, should use standard stock sizes, dimensions and size of masonry openings being given in the accompanying tables which the vast majority of requirements.

For each mullion between grouped, double-hung windows allow 6 inches and between casement windows 2 inches. The

stock window frames, which are essentially the same as those used in frame construction, require no more labor to set and brace than in case of frame walls. All that is necessary is to

FIG. 4,291.—Brick sill with window frame in position. Brick sills are the cheapest, the brick should be laid on edge and pitched 1 in. 6 or 9½ degrees as explained in the text. Brick laid flat with a pitch formed with cement are not satisfactory, as the action of the weather may cause the cement to loosen. Allow the bottom of the brick to project slightly beyond the face of the wall to form a drip. Door sills may be laid of brick, providing the brick be suitable for this purpose.

box them in to make a housing for the sash weights. After the brickwork is laid around the frame, a staff bead or brick mould is nailed to its outside face, fitting snugly up to the brickwork, adding if so desired a scribing bead.

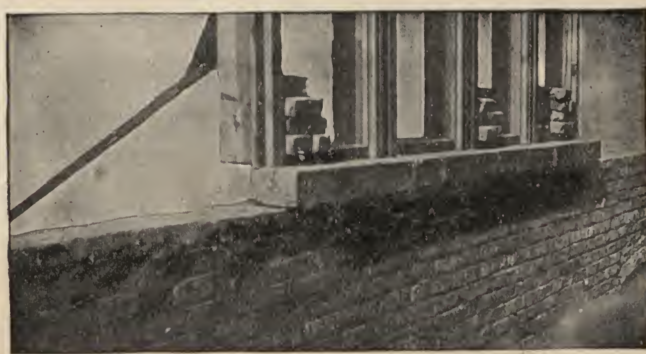


FIG. 4,292.—Window frame set ready for the bricklayer. Window frames are always set plumbed and braced by the carpenter, although the bricklayer should understand how to do it, especially if he work in remote sections.

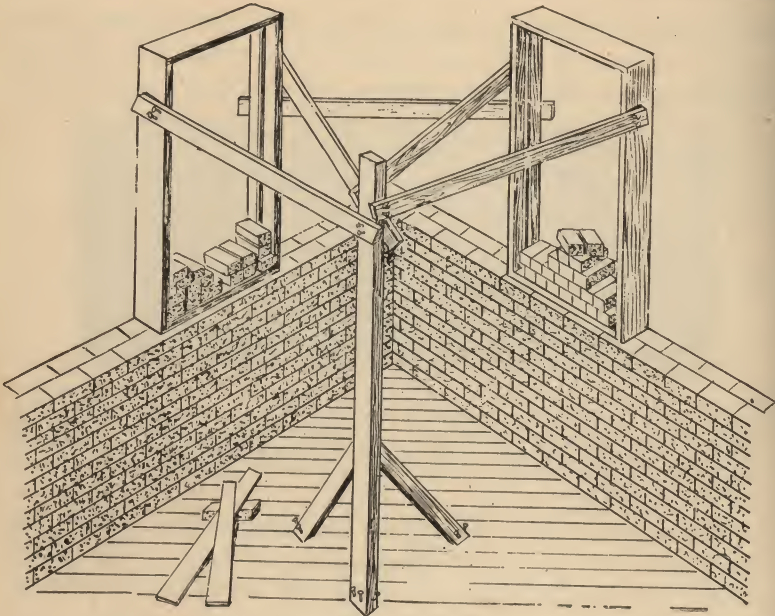


FIG. 4,293 —Method of bracing window frames to allow room for scaffold beneath braces. ***In bracing***, place an upright at about the center of a small house, braced in two directions near the brace with short pieces of plank. All the window frames on the story are then braced to the upright with braces placed horizontally, near the top of the frame, sloping braces being entirely avoided. This provides clear working space under the braces and scaffolding can be moved around at will. The carpenter should pile a few brick on the sill to assist in holding the frame steady. If he fail to do this, the bricklayer should place them himself before starting to brick the window in.

FIG. 4,294.—Window frame set plumbed, braced and partially bricked up; view from interior showing bracing.

Should local stock frames vary slightly from the dimensions given, or if a scribing bead be used in addition to the regular staff mould, the brickwork can be easily laid so as to take up the difference. In case the masonry opening is finished before the frames arrive on the job, great care should be taken to have them built the exact size of the frame ordered, always taking into consideration the 1 inch to 6 inches slope of the sill, and the scribing bead if used.

The only difference between double hung windows for frame and for brick walls is that the latter are boxed in at the jambs

FIG. 4,295.—Window frames braced in position and being bricked up.

to provide a housing for the weights and that they have a staff bead outside. It is cheaper, however, to buy stock frames for brick walls with the box in place than to have the carpenter on the job make the box.

Setting Window and Door Frames.—Window and door frames for brick walls are made by all mill work concerns. They are set by the carpenter, window frames being placed on top of the sill on a thin bed of mortar. A much better job is made if they be set before the wall has risen above the sill

level. They are levelled, plumbed and braced so that the braces will not interfere with the placing of the scaffold, as shown in fig. 4,294.

When they are leveled, plumbed and braced, the brickwork

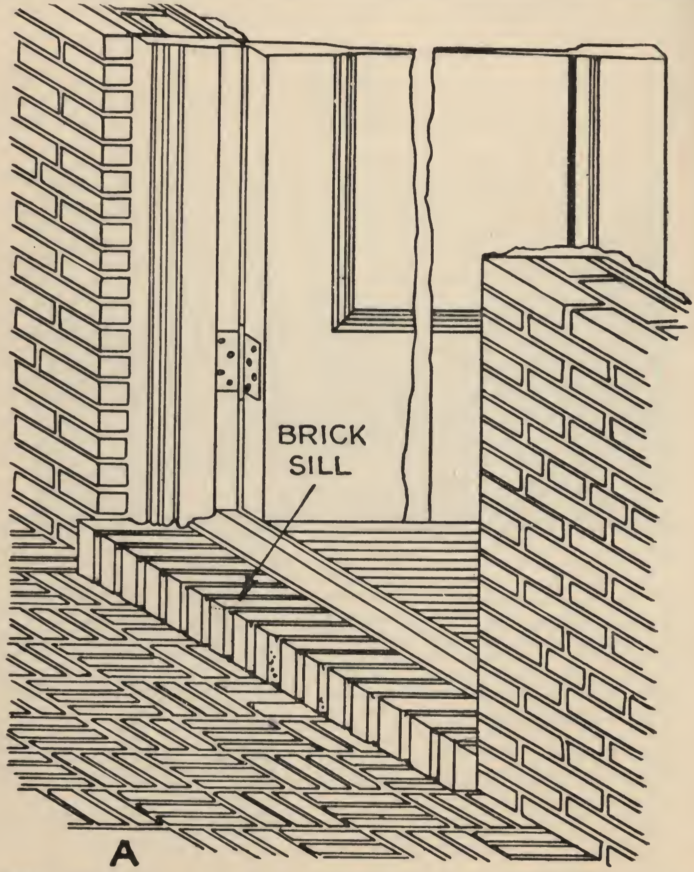


FIG. 4,296.—Exterior door opening with door and frame set, showing edge sill brick bringing frame up to second course level, also brick porch floor laid on edge.

is carried up around the jambs or weight boxes, as shown i
fig. 4,285, always making certain that the corner or jamb c
the brick opening is perfectly plumb. Great care should b
taken to fill solid with mortar the spaces between the brick
work and the window frame, to stop the wind.

Frames should always be constructed so that there is no straight joi
at the back of the frame from front to back of the wall. A "windstop
should be nailed on all such frames so that shrinkage of the frame will n
allow drafts to blow through into the house.

If a door frame or casement window frame be high a cross piece should

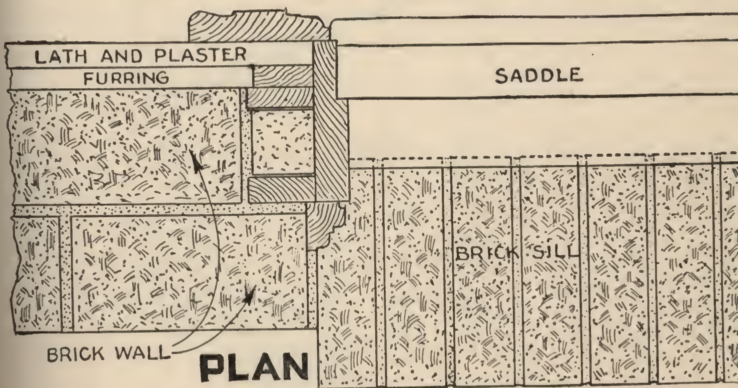


FIG. 4,297.—Enlarged plan showing sectional view of the door jamb of fig. 4,296.

nailed on the frame to prevent the window being lowered in. The b
stiffens a double hung frame considerably.

The openings for interior frames are generally formed in brick and t
frames set afterwards.

No more time is required to set window or door frames in a brick th
in a frame house. The carpenter does the setting and bracing, the bric
layer simply bricks them in.

Setting, bracing and plumbing a single, double or triple window fra
requires from 25 to 30 minutes carpenter's time.

Door Openings.—Sills for doors may be of wood, brick

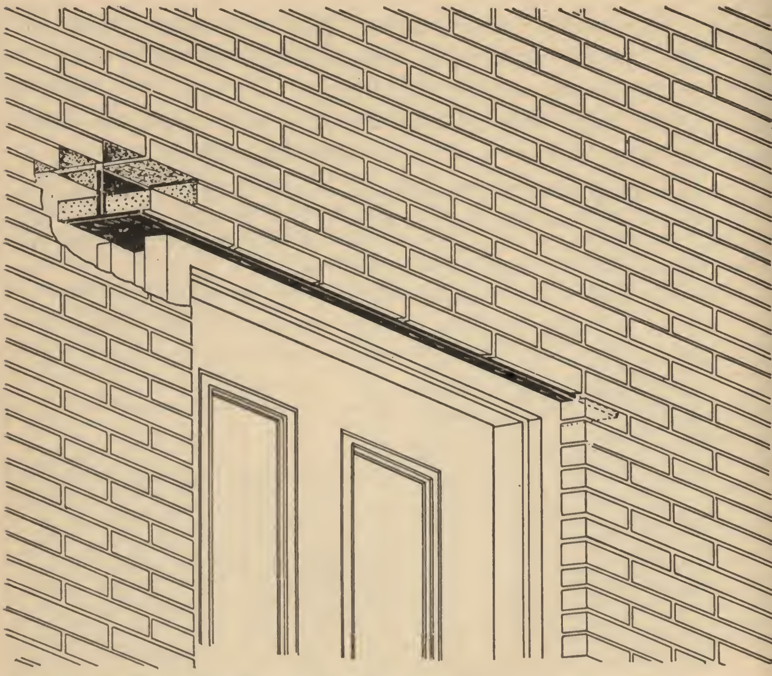


FIG. 4,298.—Exterior door opening with door set showing construction at the top, using steel T lintel.

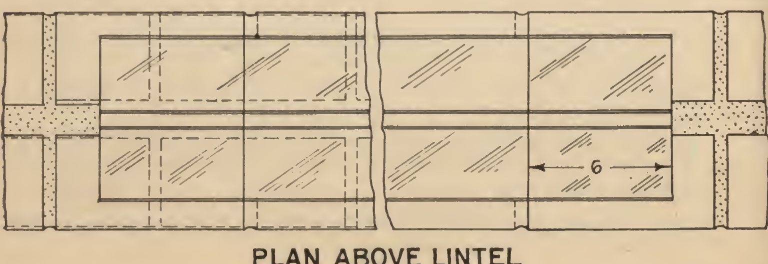


FIG. 4,299.—Enlarged plan showing construction at the top of door opening illustrated in fig. 4,298.

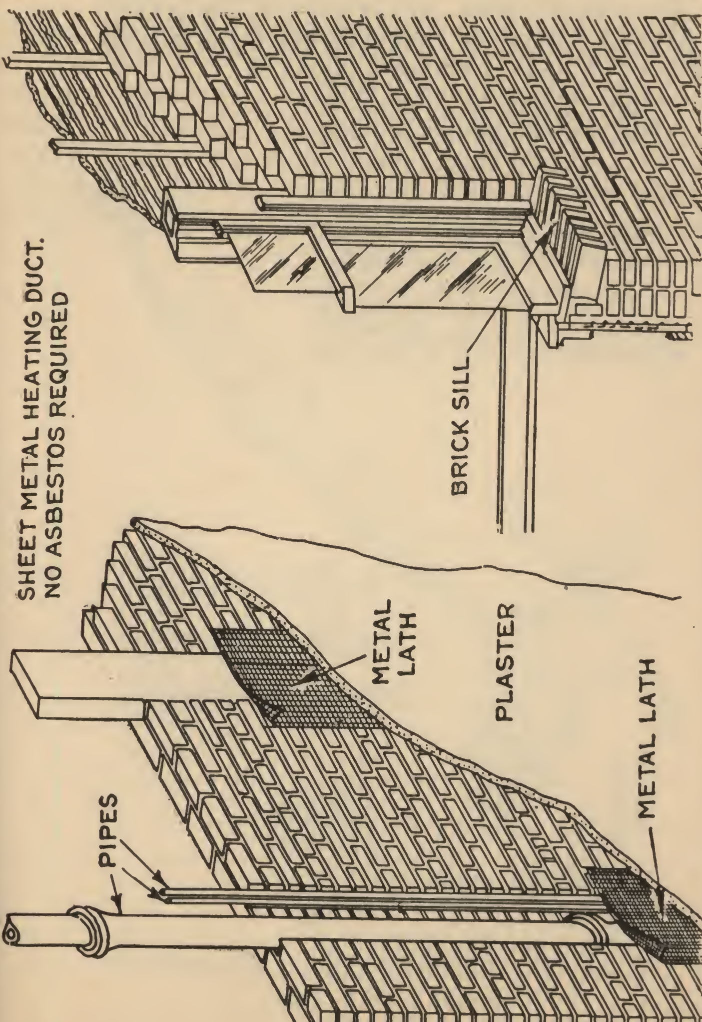


FIG. 4,300.—Method of constructing 8 in. interior partition wall to accommodate pipes and heating duct.
FIG. 4,301.—Detail of extension wall and window setting. All walls 8 ins. thick must be furred as shown.

stone. In case of a stone sill, it should be exactly the height of either two or three courses of brick.

The general methods of laying are similar to those for window openings. The sill brick may be laid flat or on edge. Fig. 4,296 shows a door open with sill brick on edge, a detail of the door jamb being shown in fig. 4,297. The construction at the top is shown in figs. 4,298 and 4,299 showing application of steel T lintel for supporting the brickwork.

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